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# ACCOUNTING FOR BIOLOGICAL ASSETS

## DISCLOSURE, MEASUREMENT AND VALUE RELEVANCE

Doctoral Thesis in Business and Management Sciences

Specialization in Accounting and Management Control

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## Biographic note

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Academically, she obtained a degree in Economics graduating from the Faculty of Economics of the University of Porto in 1999. In order to further develop her knowledge in the field of Accounting she also achieved a Master degree in Accounting at the same institution in 2004.

Professionally, she worked as an auditor in Moreira, Valente & Associados, S.A. between 1999 and 2001. Since 2001, she has been working at Centrar – Centro de Serviços de Gestão, S.A. (RAR Group) at the accounting department. Nowadays she holds a position of supervisor, where she is assigned tasks and responsibilities related to closing accounts under International Financial Reporting Standards (IFRS), complying with tax obligations and monitoring external audits. Between 2006 and 2012 she taught courses in accounting and management at Faculty of Economics of the University of Porto. Recently she was admitted for teaching another course in accounting in the same institution.

Rute is a member of two research associations, namely, European Accounting Association (EAA) and Portuguese Network of Accounting Research (GRUDIS).

During the research process, she has participated and presented communications in several seminars, organised by entities like EAA, GRUDIS, European Institute for Advanced Studies in Management (EIASM) and Spanish Association of Accounting and Business (AECA). Recently, she published a research paper in Portuguese Journal of Accounting and Management.

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## Abstract

This thesis explores accounting for biological assets under International Accounting Standard (IAS) 41 – Agriculture. The study focuses on listed firms worldwide which comply with the criteria of having first adopted International Financial Reporting Standards (IFRS) before 2012.

IAS 41 has motivated intense debate on accounting for agricultural activity, mostly due to introducing severe changes in measurement of biological assets: from historical cost to fair value. Recently, International Accounting Standards Board (IASB) settled adjustments in this standard, allowing firms to choose between cost or revaluation model concerning mature bearer plants.

In order to provide a better understanding of IAS 41 in listed firms, a theme that has yet received scarce academic attention, this study aims at achieving two main objectives. Firstly, to identify the firm and country-level determinants that explain disclosure and measurement practices of biological assets. Secondly, to examine the value relevance of measuring those assets at fair value.

Regarding disclosure practices, empirical results suggest that the mandatory and voluntary disclosure level is influenced by biological assets intensity, ownership concentration, firm size, sector and legal status. Regarding measurement practices, evidence shows that fair value adoption is influenced by biological assets intensity, firm size, listing status, regulation expertise, potential growth, sector and legal status. Concerning value relevance, this research adjusts the Ohlson model (Ohlson, 1995) and suggests that biological assets at fair value are value relevant, in particular for firms that show a higher disclosure level.

This study seeks to help standard setters and firms' stakeholders to better understand disclosure and measurement practices of biological assets and their determinants. Additionally, it intends to contribute to increased awareness about the market valuation implications of IAS 41 and to identify new areas of research on the issue of accounting for biological assets.



**Keywords:** biological assets, disclosure index, measurement, value relevance, financial reporting

## Resumo

Esta tese explora as práticas de contabilidade dos ativos biológicos em conformidade com a norma *International Accounting Standard (IAS) 41 – Agriculture*, para empresas com títulos cotados, à escala mundial, com ano de adoção das normas *International Financial Reporting Standards (IFRS)* anterior a 2012.

A norma *IAS* 41 tem motivado o debate da contabilidade sobre a actividade agrícola, dada a alteração radical que introduziu ao nível da mensuração, pela mudança de valorização ao custo histórico para o justo valor. Recentemente, o *International Accounting Standards Board (IASB)* alterou esta norma e estabeleceu que as empresas poderão escolher entre o modelo de custo e de revalorização para mensurar ativos biológicos de produção maduros, as plantas.

Com a presente tese pretende-se atingir dois principais objetivos. Primeiro, identificar factores ao nível da empresa e país que expliquem as práticas de divulgação e de mensuração dos ativos biológicos. Segundo, explorar a relevância do justo valor na mensuração daqueles ativos.

Quanto às práticas de divulgação, os resultados da presente investigação permitem concluir que o nível de divulgação obrigatória e voluntária é influenciado pela intensidade dos ativos biológicos, concentração da propriedade, dimensão da empresa, setor e posição legal. Quanto à adoção do justo valor a evidência empírica sugere que esta é influenciada pela intensidade dos ativos biológicos, dimensão da empresa, presença em bolsa estrangeira, experiência da regulação, crescimento potencial, setor e posição legal. Quanto à relevância, esta investigação ajusta o modelo de Ohlson (Ohlson, 1995) e os resultados sugerem que os ativos biológicos ao justo valor são relevantes, em particular para as empresas com um maior nível de divulgação.

Este estudo contribui para uma melhor compreensão sobre as práticas de divulgação e de mensuração dos ativos biológicos e seus determinantes, que se estima ser útil para entidades normalizadoras e *stakeholders* das empresas e ambiciona conhecer as implicações da valorização do mercado sobre a norma *IAS 41.* Adicionalmente, esta tese identifica novas áreas de investigação sobre a contabilidade dos ativos biológicos.



**Palavras-chave:** ativos biológicos, índice de divulgação, mensuração, relevância, relato financeiro

## List of abbreviations

AASB - Australian Accounting Standards Board

CFO - Chief Financial Officer

CPC - *Comitê de Pronunciamentos Contábeis*

EU - European Union

FASB - Financial Accounting Standards Board

GAAP - Generally Accepted Accounting Principles

IAS - International Accounting Standard

IASB - International Accounting Standards Board

IASC - International Accounting Standards Committee

IFRS - International Financial Reporting Standards

MASB - Malaysian Accounting Standards Board

OLS - Ordinary Least Squares

PwC - PricewaterhouseCoopers

R&D - Research and Development

SBF - *Société des Bourses Françaises*

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*To my father António*

# CHAPTER 1

# Introduction

## 1.1. Background and motivation

International Financial Reporting Standards (IFRS)[1] are a global recognised set of standards for financial reporting purposes, especially for preparation of financial statements. IFRS provide guidance on the preparation of financial information of listed firms that insure more than half of the world's gross domestic product (IFRS Foundation, 2015). IFRS focus on three main issues, namely: transparency – supporting decision-making of investors; accountability – providing a comparable information source; and efficiency – improving capital allocation. Over one hundred countries require or allow the usage of IFRS for all or most domestic publicly accountable entities (Daske *et al.*, 2013).

Several potential benefits related to IFRS are supported in the literature, namely high quality of the standards, lower cost of capital, increased investor demand for securities and stock market liquidity (Amiraslani *et al.*, 2013; Ball, 2006). However, the socio-economic environmental differences between countries have reduced the even implementation of these standards and therefore their quality (Tsalavoutas *et al.*, 2014; Amiraslani *et al.*, 2013; Wysocki, 2011; Ball, 2006). Furthermore, it seems that firm-level determinants influence the governance and incentive instruments and consequently affect the compliance with IFRS (Amiraslani *et al.*, 2013; Wysocki, 2011).

IFRS include the controversial concept of fair value. Despite that fair value is responsible for volatility of results and for encouraging some decision-making preference, it also provides more information into financial statements (Ball, 2006; Hitz, 2007). Fair value accounting is applied to three main types of assets, namely: financial instruments (with easy access to market price), investment property (with feasible future cash flow estimate) and agriculture and embraces present value techniques (Barlev and Haddad, 2003). Concerning agriculture, there was a strong expectation regarding the use of fair value due to the existence of a highly developed future and active market for commodities. Conversely to financial instruments, which have an active market, every

[1] International Financial Reporting Standards (hereafter IFRS) are standards issued by International Accounting Standards Board (IASB). The Regulation (EC) no. 1606/2002 requires that listed firms in European Union (EU) prepare their consolidated financial statements under IFRS for years beginning on or after January 1, 2005. IFRS include International Accounting Standards (hereafter IAS) and their interpretations adopted by IASB from its predecessor, International Accounting Standards Committee (IASC).

so often non-financial assets, such as investment property and biological assets, face the constraint of a more difficult fair value assessment (Barlev and Haddad, 2003).

Due to the relative importance of the agricultural sector in global economy, accounting in this area received little attention from researchers until the implementation of International Accounting Standard (IAS) 41 – Agriculture (Fisher and Marsh, 2013; Fisher *et al.*, 2010; Herbohn and Herbohn, 2006). Prior to 2005, for example, in the United Kingdom, biological assets were usually measured at historical cost (less accumulated depreciation and any impairment losses). Harvested agricultural produce was recorded as inventories and measured at the lower of cost and net realizable value (Cairns *et al.*, 2011).

IAS 41 was originally issued in December 2000 and firstly applied to annual periods beginning on or after 1 January 2003[2]. This standard prescribes the accounting treatment for biological assets during the period of biological transformation and also for the initial measurement of agricultural produce at the point of harvest.

The disclosure required by IAS 41 comprises both financial and non-financial information that corresponds mainly to mandatory information and also to some recommended information. Paragraphs [IAS 41.40-57] cover mandatory information, except paragraphs [IAS 41.43] and [IAS 41.51], which correspond to recommended information.

Disclosure practices of accounting for biological assets seem pertinent to investigate due to the increased disclosure requirements brought by IAS 41 and given that this research topic has not been widely discussed so far.

Moreover, empirical evidence shows that international accounting practices are dissimilar and, additionally, it is possible that determinants related to the country of origin explain the differences in accounting practices (Nobes, 2008). For example, Elad and Herbohn (2011) suggest that countries like Australia and the United Kingdom exhibit a higher disclosure level of biological assets than other countries, like France.

The beginning of this dissertation focuses on analysing disclosure practices under IAS 41 with the intent to enrich the overall understanding of firms' behaviour where

[2] There are other IFRS that have made minor consequential amendments to IAS 41. They include IAS 1 Presentation of Financial Statements (as revised in December 2003 and in September 2007), IAS 2 Inventories (as revised in December 2003), Improvements to IFRS (issued in May 2008) and IFRS 13 Fair Value Measurement (issued in May 2011).

biological assets are concerned. This analysis is done through the use of worldwide evidence and provides an examination of the impact of specific determinants related to firms and countries on mandatory and voluntary disclosure of biological assets. This research of firms' disclosure practices was considered an essential basis for the subsequent analysis of more complex issues such as measurement practices and the examination of the value relevance of fair value of biological assets.

As a simple rule, IAS 41 requires biological assets to be measured on initial recognition and at subsequent reporting dates at fair value less costs to sell. The single exception allowed to fair value measurement is applied only to initial recognition and within a strict context: a market-determined price is not available and the entity cannot assure a reliable estimate of fair value [IAS 41.30]. In such conditions, the entity uses the unreliability clause of fair value and recognises biological assets at cost less depreciation and impairment. Also, agricultural produce should be measured at fair value less costs to sell at the point of harvest.

Bearing in mind the mandatory requirement of IAS 41 to measure biological assets at fair value, to examine it as a matter of choice may seem unreasonable. Theoretically, followers of the unreliability clause of fair value should match the firms with no conditions to measure biological assets at fair value. Nonetheless, and following prior literature, it is likely that there are other reasons that could explain the adoption of historical cost, even when the clause does not apply (Elad and Herbohn, 2011; Fisher *et al.*, 2010; Elad, 2004). Consequently, it could be challenging to find out firm and country-level determinants that could support different measurement practices.

According to this standard, biological assets should be divided into bearer biological assets and consumable biological assets. In terms of market valuation implications of this standard, fair value assessment diverges under this classification. Rather than agricultural produce, bearer biological assets are self-regenerating (for example, livestock from which milk is produced, grape vines, fruit trees and trees from which firewood is harvested while the tree remains [IAS 41.44]). Usually, for this type of biological assets fair value is achieved differently. For example, "in case of the wine-growing sector (…) it is difficult to find active market due to the characteristics of the vines and the corresponding grapes in the different regions" (Azevedo, 2007:21). Conversely, consumable biological assets are harvested as agricultural produce or sold

as biological assets (for example, livestock intended for production of meat, livestock held for sale, fish in farms, crops such as maize and wheat, and trees grown for lumber [IAS 41.44]). Frequently, there is an active market for this type of biological assets. For that reason, the corresponding fair value can be easily determined.

Although there are studies that confirm that accounting information related to biological assets has impact on investors' decision-making (Silva Filho *et al.*, 2013; Argilés Bosh *et al.*, 2012; Argilés *et al.*, 2011), there are others that do not support value relevance in the biological assets domain (Machado *et al.*, 2013; Martins *et al.*, 2012).

Hence, and given recent data, it could be motivating to infer about how accounting information, concerning fair value of biological assets, is reflected in share prices and how it influences investors' decision-making. After analysing disclosure and measurement, conditions would be met to develop research on relevance of the fair value, as a second issue in this research.

Moreover, and in order to enhance previous studies related to biological assets and to assure some synergy in the whole dissertation, it could be particularly interesting to analyse market valuation impact including both means of decision usefulness, disclosure and measurement. This issue has also a theoretical support. Regarding International Accounting Standards Board (IASB) conceptual framework for financial reporting, disclosure is not a replacement of recognition. In order to be recognised, an item must have "a cost or value that can be measured with reliability" (paragraph no. 4.38.b), Conceptual Framework for Financial Reporting). The same criteria are not applied for disclosed items. Nonetheless, Choudhary (2011) and Holthausen and Watts (2001) support that recognition suggests less reliability, considering managers are more encouraged to manipulate recognised items than disclosed items.

Recently, IASB has amended IAS 41 in what it refers to bearer plants. Firstly, IASB issued an exposure draft in June 2013 (IFRS Foundation, 2013a) that recommended several amendments to accounting requirements for bearer plants, such as tea bushes, grape vines and oil palms. This project was developed in the context of a primary issue by Malaysian Accounting Standards Board (MASB), which proposed, as an alternative to fair value, that bearer biological assets be removed from IAS 41 and inserted in IAS 16 – Property, plant and equipment. In this context, a bearer plant is a living plant that is used in the production or supply of agricultural produce and it is expected to bear

produce for more than one period, having remote likelihood of being sold as agricultural produce, except for incidental scrap sales [IAS 41.5]. The amendments take into consideration bearer plants (prior to reaching maturity) and its measurement at accumulated cost, such as self-constructed items of property, plant and equipment. Additionally, entities will be permitted to choose either the cost model or the revaluation model for mature bearer plants under IAS 16. Produce growing on bearer plants should be accounted for at fair value in accordance with IAS 41. These amendments are effective for annual periods beginning on or after 1 January 2016, with earlier application being permitted (IFRS Foundation, 2014).

In the beginning of 2014, within the context of this project, IASB discussed some issues, namely: the scope of the amendments, accounting for produce growing on bearer plants and guidance to apply IAS 16 to bearer plants. IASB has listened to investors, analysts and other users of financial statements and they all stated that fair value measurement under IAS 41 provides limited information. These financial users are concerned about the reliability of fair value measurements, with regard to management judgment. Specifically, information about bearer plants is not very useful without fair value information about related land, land improvements and agricultural machinery (IFRS Foundation, 2014).

In brief, three reasons have supported this change. Firstly, fair value measurement for bearer plants in the absence of the corresponding market is complex, costly and implies practical constraints. Moreover, changes in fair value less costs to sell are recognised in profit or loss and imply results volatility. Secondly, mature bearer plants are assumed as manufacturing assets, since they are no longer undergoing significant biological transformation. Finally, the reported profit or loss is adjusted by financial users to eliminate effects of changes on fair valuation of bearer biological assets, because their focus is on the revenue from the produce growing of these assets. Overall, these adjustments are expected to reduce compliance costs, complexity and profit volatility for preparers, without a significant loss of information for users of their financial statements. They also provide relief from retrospective restatement by permitting an entity to use the fair value of an item of bearer plants as the deemed cost at the start of its earliest comparative period (IFRS Foundation, 2014).

In order to anticipate and also to support in some sense this change, after exploring disclosure at preliminary stage, it could be interesting to explore empirical essays regarding measurement and value relevance in the present research, taking into account the classification under IAS 41, namely bearer biological assets and consumable biological assets. In the overall, IAS 41 is far from stabilising and enhances timeliness and relevance of this study.

## 1.2. Purposes

Based on previous considerations regarding accounting for biological assets under IAS 41, this thesis embraces two main goals and the corresponding research questions.

The first objective aims to identify the firm and country-level determinants that could explain mandatory and voluntary disclosure and measurement practices of biological assets under IAS 41 with the following research questions:

(i) What is the disclosure level on biological assets in listed firms under IAS 41?

(ii) What firm and country-level determinants explain the differences in the disclosure level on biological assets among listed firms?

(iii) What firm and country-level determinants explain the differences in practices used to measure biological assets among listed firms?

The second objective aims to examine the value relevance of fair value of biological assets under IAS 41 in order to investigate the market valuation implications of this standard. Therefore, the following research questions are considered in this research:

(i) Are biological assets at fair value value relevant under IAS 41?

(ii) Is there a difference in the value relevance of biological assets between listed firms with high and low disclosure level on biological assets?

After introducing the main purposes of this dissertation, next section will briefly describe some considerations in respect with theoretical background.

## 1.3. Theoretical background

In a conceptual perspective, there are several theories that could explain firm-level determinants of disclosure practices, such as: agency theory (Jensen and Meckling, 1976) and signalling theory (Morris, 1987). Additionally, firm-level determinants of

measurement practices could be supported by agency theory (Jensen and Meckling, 1976) and accounting choice theory (Fields *et al.*, 2001; Watts, 1992; Zmijewski and Hagerman, 1981). Based on a transversal perspective, contingency theory supports country-level determinants of disclosure and measurement practices (Doupnik and Salter, 1995).

Agency theory defines the incentive problems in firms motivated by the ownership and control separation – the principal (owner of the firm) and the agent (manager) problem (Jensen and Meckling, 1976). In this sense and where disclosure practices are concerned, managers are strongly motivated to disclose complete information in order to achieve their compensation. For example, bearing in mind larger firms, they are expected to have higher agency costs; therefore, these firms are also influenced to improve the information level to stakeholders and financial analysts. Consistent with the previous considerations, signalling theory is implied by positive monitoring costs in agency theory (Morris, 1987). Under information asymmetry, a listed firm in several stock exchanges that develops international trading activities has more information to control and consequently, is interested in signalising its position to stakeholders by improving disclosure.

Considering accounting choices, the related theory comprises the firm manager's choice of one accounting method over another (Watts, 1992), which corresponds in this study, to choose between fair value and historical cost as valuation method. Given market imperfections such as transaction costs and externalities, Fields *et al.* (2001) state that accounting choices are used by managers to disseminate their private information and to influence the beliefs of rational investors. Moreover, accounting choice could detect the economic determinants that move managers towards certain directions (Zmijewski and Hagerman, 1981) and could explain how these determinants could be changed. This would be particularly helpful for accounting regulators to anticipate, for example, how firms would answer to a change in accounting rules.

In what it concerns to contingency theory and according to Doupnik and Salter (1995), the external environment, the institutional structure and the cultural values support accounting divergence between countries. The external environment comprises various factors, namely legal system, relationship between business and providers of capital, tax laws, inflation levels, political and economic ties, level of education and

level of economic development. For example, and transposing to the present study, the legal system (to belong to a code law versus a common law country) and the relation between tax rules and accounting (strong or weak) have an impact in the extent of disclosure and in fair value adoption.

Finally, value relevance of biological assets under IAS 41 is explored under the theory of asymmetric information (Glaum *et al.*, 2013; Hitz, 2007; Healy and Papelu, 2001), which assures a strong background for the valuation purpose of financial reporting. Trustworthy and opportune information decreases the risk of valuation calculated by investors and enhances decision-making assessment (Glaum *et al.*, 2013). Thus, measurement contributes to the decision usefulness objective (Hitz, 2007) and additionally, disclosure mitigates information asymmetries in capital markets and reduces the cost of capital (Glaum *et al.*, 2013; Healy and Palepu, 2001). Nonetheless, financial statements are not effective in decreasing information asymmetries, if financial reporting is tendentiously partial and not complete (Glaum *et al.*, 2013).

## 1.4. Methodology

This thesis explores a selection of listed firms worldwide that complies with the criteria of having first adopted International Financial Reporting Standards (IFRS) before 2012. This research includes data from three periods of analysis in order to get more recent data and to maximise the number of firms to be analysed. The three periods correspond to both research goals: 2011, to examine disclosure practices; 2012 to study measurement practices; and a three-year period from 2011 to 2013 to explore the value relevance of biological assets under IAS 41. IFRS 1 – First-time Adoption of IFRS allows some exemptions and exceptions which may cause some constraints when analysing and making inferences about the information of the year of adoption (Callao Gastón *et al.*, 2010). Consequently, 2010 should be the limit year to consider firms that adopted IFRS (or equivalent standards) to examine disclosure practices and explore the value relevance of biological assets under IAS 41. In addition, 2011 should be the limit year to consider firms that adopted IFRS (or equivalent standards) to study measurement practices.

During the research, when data were collected in DataStream, the chosen year was the most recent year with more updated information, in order to assure the maximum

possible number of countries and consequently number of firms, as well as to provide a research with recent data.

Initially, countries were selected that adopted IFRS until 2010 and 2011. Then, considering the corresponding selection of countries, were selected firms that have biological assets.

Firstly, considering disclosure practices, the study adopts an Ordinary Least Squares (OLS) regression model to test the relation between the extent of mandatory and voluntary disclosure of biological assets with firm and country-level determinants for the year of 2011.

Secondly, taking in to account measurement practices, the research considers a logit model in order to identify the firm and country-level determinants that explain differences in practices used to measure biological assets for the year of 2012. After developing the previous cross-sectional analysis with the specific purpose of explore disclosure and measurement practices, the following step consists in examining the market valuation implications of IAS 41 for biological assets that are measured at fair value.

Bearing in mind value relevance of biological assets, this study adjusts the original accounting-based valuation model developed by Ohlson (Ohlson, 1995) from 2011 to 2013, considering panel data with fixed effects.

## 1.5. Structure

After presenting a brief introduction that includes the regulatory framework regarding IAS 41, the motivation, the main purposes, the theoretical background and the methodology in this first chapter, the next chapters correspond to the three essays of this dissertation, namely: disclosure practices, measurement practices and value relevance of biological assets under IAS 41.

Chapter 2 analyses mandatory and voluntary disclosure practices of biological assets and their determinants of 270 listed firms worldwide that adopted IFRS until 2010. This essay provides a literature review of disclosure requirements of IAS 41 and of the country influence in firms' reporting practices. Besides, a disclosure index of biological assets is constructed and calculated based on the notes to the consolidated financial statements included in 2011 annual report. This essay tests the relation between the

extent of mandatory and voluntary disclosure concerning biological assets with the firm and country-level determinants using an OLS regression model.

Chapter 3 examines measurement practices of biological assets and their determinants, based on data from 2012 taking into consideration 324 listed firms worldwide that adopted IFRS until 2011. Bearing in mind the literature review, this study discusses measurement requirements of IAS 41 and the influence of firm and country-level determinants. The research model includes a binary dependent variable for measurement practice (fair value or historical cost) and explores several firm and country-level determinants that are expected to be related to the measurement of biological assets.

Chapter 4 addresses the second objective of this thesis. Based on 132 listed firms worldwide that adopted IFRS until 2010, this essay analyses the value relevance of fair value regarding biological assets. The study includes the debate of fair value relevance under international financial reporting, and then applied to non-financial assets and biological assets in particular. In order to test the market valuation implications of this standard for biological assets measured at fair value, this study adjusts the original Ohlson model (Ohlson, 1995) and considers panel data from 2011 to 2013. This essay includes also the effect of the disclosure level of biological assets.

Finally, the dissertation ends with chapter 5 that presents the main findings, introduces some limitations of the study, suggests avenues for future research and states main contributions.

# CHAPTER 2

# Accounting for Biological Assets:

# Disclosure practices of listed firms

## 2.1. Introduction

Bearing in mind a firm's financial position and performance, disclosure is a way of sharing economic, financial or non-financial, quantitative or qualitative information.

Considering mandatory disclosure, at a first sight, it appears incongruent to analyse it in terms of compliance. Furthermore, if firms are required to answer to specific information, ideally there would be no reason for differences to occur in disclosure reporting. Nonetheless, in accordance with Chavent *et al.* (2006), firms exercise some discretionary behaviour in financial reporting, where mandatory disclosures are concerned. Therefore, there is a close link with voluntary disclosure and both can be studied under the same theoretical framework. In literature, the reason why firms voluntarily disclose is related to several theories, namely, stakeholder theory, agency theory, signalling theory, legitimacy theory and political economy theory (Oliveira *et al.*, 2006; Akhtaruddin, 2005; Inchausti, 1997; Cooke, 1989).

On the topic of biological assets, before IAS 41, "current accounting principles typically do not respond very well to the particular characteristics of agricultural business and the information needs of farmers and their stakeholders" (Argilés and Slof, 2001:361). Given this standard implementation, empirical evidence (Elad and Herbohn, 2011) shows that, there are countries, such as Australia and the United Kingdom, where firms tend to disclose more detailed information on biological assets than firms from other countries, such as France. This indicates that the comparability of international accounting practices is missing and, in addition, it is probable that country-level determinants explain the differences in accounting practices (Nobes, 2008).

Furthermore, Argilés and Slof (2001) believe that IAS 41 introduces important improvements, for example, definition, valuation and presentation of biological assets and agricultural produce with supportive classifications (mature and immature biological assets, consumable and bearer biological assets). They also state that the impact of IAS 41 is mainly on conceptual level and additional tools are required for its adoption. Conversely, several authors (Silva *et al.*, 2012; Elad and Herbohn, 2011; Aryanto, 2011; Fisher *et al.*, 2010; Argilés *et al.*, 2009; Argilés Bosh, 2007; Elad, 2007 and 2004; George, 2007) raise the controversy about the "goodness" of fair value under IAS 41.

Considering disclosure practices of biological assets as documented in previous literature (Elad and Herbohn, 2011), the aim of this essay is to explore the following research questions:

- What is the disclosure level on biological assets in listed firms under IAS 41?
- What firm and country-level determinants explain the differences in the disclosure level on biological assets among listed firms?

In order to address these questions, this study establishes several hypotheses that relate to the extent of mandatory and voluntary disclosure of biological assets with firm and country-level determinants. An index of mandatory and voluntary disclosure of biological assets is built based on IAS 41 disclosure requirements and the recommended best practices by PricewaterhouseCoopers (PwC) (2011) and it is calculated based on the notes to the consolidated financial statements included in the 2011 annual report of a worldwide selection composed of 270 firms from 40 IFRS adopting countries[3]. Bearing in mind previous studies, this essay provides a wider research based on a larger number of countries and determinants with recent data. In particular, this essay emphasizes the country-level determinant, by exploring two different country classifications, namely, the common law versus code law classification supported by La Porta *et al.* (1998) and a cluster classification that exemplifies a more current perspective (Leuz, 2010).

The chapter is organised as follows: Section 2.2 provides a literature review, firstly by focusing on the debate of disclosure requirements of IAS 41, and afterwards discussing the country classification. Section 2.3 introduces the development of hypotheses. Section 2.4 describes the methodology, presenting the selection and the disclosure index. Section 2.5 discusses the findings from the empirical analysis. Finally, the essay provides a brief conclusion.

[3] The countries are Australia, Austria, Belgium, Bermuda, Brazil, Cayman Islands, Chile, China, Croatia, Cyprus, Denmark, Egypt, Faroe Islands, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Kenya, Kuwait, Latvia, Lithuania, Luxembourg, Mauritius, Netherlands, New Zealand, Norway, Oman, Peru, Philippines, Portugal, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Arab Emirates and the United Kingdom.

## 2.2. Literature review

### 2.2.1. Disclosure requirements of IAS 41

There are some studies in the literature that have assessed the implementation impact of IAS 41 (Elad and Herbohn, 2011; PwC, 2011 and 2009; Silva *et al.*, 2012; Scherch *et al.*, 2013; Theiss *et al.*, 2012). Based on an international selection of firms, and in reference to biological assets, Elad and Herbohn (2011) and PwC (2011 and 2009) suggest different disclosure level and that comparability is missing.

Elad and Herbohn (2011) have conducted a survey in order to determine perceptions from several users of financial information, such as valuation consultants, accountants and auditors of the agricultural sector in Australia, France and the United Kingdom. They have concluded that, as main lessons, the costs of measuring and reporting biological assets at fair value outweigh the benefits and that the fair value accounting model prescribed by IAS 41 increases earnings volatility. In addition, there is a lack of comparability of disclosure practices, in which French firms incline not to disclose complete information on biological assets. Besides, this study has developed a checklist of disclosures prescribed by IAS 41 and each firm was assigned a score based on the percentage of disclosed items.

PwC (2011 and 2009) has elaborated two international studies concerning the impact of adopting IAS 41 in the timber sector. The main goal was to provide what might be considered establishing best practices in fair valuing of this sector and related disclosures. Additionally, in both studies, PwC has identified the major pronouncements described on the notes of financial statements, highlighting some of the main constraints, comparisons and dissimilarities. In general, firms have different levels of transparency regarding biological assets disclosure and usually they do not discuss fair valuation assumptions, so there is an opportunity for further improvement. PwC (2011) has recommended several practices in this field, namely: to present key valuation assumptions (for example, forest and harvest plans and the complexity of the asset's structure); to discuss expected future prices and costs to better understand the valuation adopted; to provide a sensitivity analysis related to each weight assumption used in the valuation that has an effect on the value in case of a change (for example, discount rate, prices, costs and growth).

Further empirical evidence about disclosure practices relating to this standard is still scarce. For example, the following studies focus on Brazil.

Silva *et al.* (2012) have developed a disclosure index concerning the information related to the agricultural sector of 45 Brazilian firms regarding the 2010 annual report. The disclosure of biological assets types and the reconciliation of the carrying value of their changes are the most frequently reported items, but other items are neglected, such as management risks and other restrictions of biological assets. They have concluded that a higher transparency level in disclosure would help to mitigate information asymmetry. As a consequence, stakeholders would improve their understanding of the biological assets' activities.

Regarding Brazil's adoption of IFRS and a sample of 24 traded Brazilian firms in 2010, Scherch *et al.* (2013) have concluded that, on average, there was 57% of conformity with *Comitê de Pronunciamentos Contábeis (CPC) 29 - Pronunciamento técnico - Ativo Biológico e Produto Agrícola* (equivalent standard to IAS 41 in Brazil). Taking into account that IAS 41 is a new pronouncement, this study highlighted that measuring at fair value may imply several constraints to the stakeholders, including preparers and analysts. A large disclosure about biological assets would tend to reduce the uncertainty associated with biological assets reporting. In this respect, firms interested in improving the quality of their reporting shall increase the amount of informative disclosure since a considerable number of sentences is capable of enlarge the quality score (Hooks and Van Staden, 2011).

Similarly, Theiss *et al.* (2012) have investigated the implementation of CPC 29 guidelines of 21 Brazilian listed firms in 2010. Using a disclosure index, the results stated that 95% of the sample complies partially with general information on biological assets. The study has suggested that some of the information required is considered confidential by the firm administration; therefore, disclosure items were not fully disclosed. Consequently, the stakeholders, including auditors and regulators, should play an important role in analysing if the biological assets disclosure is sufficient or not.

Hence, the present study attempts to enrich the overall understanding of disclosure practices of biological assets by focusing on evidence worldwide and examining the impact of firm and country-level determinants on mandatory and voluntary disclosure of biological assets.

### 2.2.2. Country classification

Several studies have elected the institutional factor as the main influence for firms' reporting practices (Wysocki, 2011; Nobes, 2008; Djankov *et al.*, 2003). In fact, even though the aim with IFRS is to assure accounting comparability between countries, it does not eradicate the national, industry and firm-level institutional influences (Wysocki, 2011).

Taking into consideration this seminal factor, some country's classifications have been developed in the literature (Leuz, 2010; Nobes, 2008; La Porta *et al.*, 1998).

La Porta *et al.* (1998) have analysed legal rules related to shareholders and its origin and the quality of enforcement in 49 countries. They have divided the firms by common law and code law country classification. Nobes (2008) has classified countries into two groups, namely strong equity, commercially driven (for example, the Netherlands and the United Kingdom) and weak equity, government driven, tax-dominated (for example, Germany, France and Italy).

Nowadays, there are other alternative taxonomies to the common law versus code law perspective, for example, cluster classification (Leuz, 2010) using regulatory and reporting practice variables. Leuz (2010) has suggested that outsider economies with large and developed stock markets, dispersed ownership, strong investor protection and strong enforcement (cluster 1) show higher disclosure scores and more informative earnings than insider economies with less developed stock markets, concentrated ownership and weak investor protection. Insider economies are divided into two clusters, diverging in the strength of their legal systems; as a result, those economies with strong enforcement (cluster 2) show higher transparency scores than the others (cluster 3). Furthermore, there is empirical evidence that corroborates the paradigm is changing. For example, Hellmann *et al.* (2013) have investigated if Germany is moving from the traditional Continental European accounting model to a middle position between this one and the Anglo-American accounting model, with the promulgation of the Act to Modernize Accounting Law (issued in May 2009). This Act assured some reforms to the code and to accounting principles, for example, to eliminate the straight liaison to tax rules and to settle new recognition and valuation rules (Hellmann *et al.*, 2013). Also, Callao Gastón *et al.* (2010) and Lewis and Salter (2006) have argued that

the United Kingdom should be included in the European accounting model, instead of being considered a common law country.

## 2.3. Development of hypotheses

Based on previous studies, this essay focuses on the following two research questions:

- What is the disclosure level on biological assets in listed firms under IAS 41?
- What firm and country-level determinants explain the differences in the disclosure level on biological assets among listed firms?

Conceptually, several theories can explain firm disclosure. The positive accounting theory supports the effort of explaining and predicting accounting practices, in this case related to biological assets. The main goal of positivist accounting research is to corroborate a specific accounting fact with related causal explanations (Luft and Shields, 2014; Ittner, 2014). Although the results must be reproduced by other researchers in an equivalent domain and reliable within their peers, usually these explanations have implicitly a subjective decision. In order to assure causality, there is a need to eliminate alternative causal explanations. According to Luft and Shields (2014), there are two possible ways of doing that. Firstly, by providing credible evidence against other possible justifications. Secondly, by narrowing the specification of context that reduces the number of alternative causal explanations. This essay adopts the second possibility, electing firm and country-level segments.

Glaum *et al.* (2013) have supported that firm-level determinants are more relevant than country-level determinants in more advanced countries with developed markets and institutions. Otherwise, in less developed countries, the country-level determinants are more significant than firm-level determinants. Regarding the diversity of countries of the selected 270 listed firms worldwide, it seems advisable to investigate both influences.

The research model includes a disclosure index and explores several determinants that are expected to be related to the disclosure level, namely, firm-level variables – biological assets intensity, ownership concentration, firm size, auditor type, internationalisation level, listing status, profitability, sector – and country-level variable

– legal status. As explained in the next sub-section, the selected variables are supported by other studies that also focus on disclosure practices. Therefore, this study aims to realise if the same expectations and results are obtained in the particular context of biological assets.

For each independent variable, the causal mechanisms and the supporting theories are identified and explained as follows.

### 2.3.1. Firm-level variables

- Biological assets intensity

Scherch *et al.* (2013) have stated that the disclosure level rises with the increasing intensity of biological assets. Considering other non-financial assets, for example goodwill impairment, firms have a higher propensity to disclose when they have larger amounts of non-financial assets (Amiraslani *et al.*, 2013; Heitzman *et al.*, 2010). Moreover, goodwill impairment requires valuation skills, so there is also a strong expectation that firms allocate more resources to improve quality report when they have a relative materiality position (Glaum *et al.*, 2013; Shalev, 2009). Another example is the disclosure level of provisions, which is also related to the corresponding amount of provisions (Chavent *et al.*, 2006).

That could be the case of biological assets, given the complexity of measurement and disclosure requirements. Bearing in mind the stakeholder theory, Silva *et al.* (2012) have expected preparers of financial reporting of biological assets to assure the disclosure level regulated by IAS 41 in order to provide information to users of such financial statements. This statement is even more significant if firms have material amounts of biological assets, given the previous examples of goodwill and provisions.

The above considerations indicate an expected positive sign for the relation.

**H1:** There is a significant positive association between biological assets intensity and the extent of mandatory and voluntary disclosure concerning biological assets.

- Ownership concentration

The firms' reporting incentives are influenced by ownership structure (Glaum *et al.*, 2013; Leuz, 2010). Considering that agency problems arise because of the separation of

ownership and control (Jensen and Meckling, 1976), agency costs increase as the ownership structure becomes more dispersed (Fama and Jensen, 1983). In order to decrease agency costs, firms with higher ownership diffusion have stronger incentives to provide transparent financial reporting (Oliveira *et al.*, 2006).

Also, IFRS are settled to assure that information is provided to shareholders, to decrease information asymmetry between managers and external users and to enhance disclosure transparency (Ding *et al.*, 2007). For firms that are controlled by several investors, higher demand for public disclosure may also lead to higher incentives for disclosure (Daske *et al.*, 2013).

The above considerations indicate an expected negative sign for the relation.

**H2:** There is a significant negative association between ownership concentration and the extent of mandatory and voluntary disclosure concerning biological assets.

- Firm size

Some studies indicate firm size as a determinant of compliance with reporting standards (Amiraslani *et al.*, 2013; Glaum *et al.*, 2013; Oliveira *et al.*, 2006). Glaum *et al.* (2013) have demonstrated that larger firms are responsible for disclose financial information with more quality than smaller firms, since the formers usually have more allocated resources to accounting divisions. Depoers (2000) has confirmed this argument. Furthermore, costs of increased disclosure are well supported by larger firms (Amiraslani *et al.*, 2013).

Larger firms are likely to have a higher percentage of outside capital and also enlarged agency costs (Jensen and Meckling, 1976); consequently, these firms are required to assure a more developed level of information to stakeholders, especially financial analysts (Depoers, 2000).

The above considerations indicate an expected positive sign for the relation.

**H3:** There is a significant positive association between firm size and the extent of mandatory and voluntary disclosure concerning biological assets.

- Auditor type

Auditing is an effective function of restraining managers' opportunistic reporting conduct (Tsalavoutas, 2011). Consequently, and regarding agency theory, independent auditors reduce agency costs (Jensen and Meckling, 1976). Watts and Zimmerman (1983:615) have emphasised that it is possible "(…) only if the market expects the auditor to have a nonzero level of independence". Committees and penalties, including reputation loss, are some of the incentives for auditors to assure their independence. To avoid reputation costs, these firms demand a higher disclosure level (Oliveira *et al.*, 2006; Chalmers and Godfrey, 2004).

Furthermore, prior literature explains the strength of enforcement of accounting standards by the existence of stronger audit firms (Hope, 2003). The larger the audit firm, the higher is its perceived quality (DeAngelo, 1981). Several studies have revealed a positive association between disclosure level and being audited by the Big 4 auditing firms (Glaum *et al.*, 2013; Cascino and Gassen, 2011; Hodgdon *et al.*, 2009).

The above considerations indicate an expected positive sign for the relation.

**H4:** There is a significant positive association between auditor type and the extent of mandatory and voluntary disclosure concerning biological assets.

- Internationalisation level and listing status

The disclosure level is positively related to the degree of foreign activity in the firm (Daske *et al.*, 2013; Amiraslani *et al.*, 2013) and to the firm's listing status (Amiraslani *et al.*, 2013; Cooke, 1992). Managers of firms that operate in several geographical areas have to provide larger disclosure, bearing in mind the higher complexity of the firms' activities (Cooke, 1989).

Due to signalling theory, international trading activities (Oliveira *et al.*, 2006; Depoers, 2000) and the presence in several stock exchanges (Oliveira *et al.*, 2006; Hope, 2003) imply large and complex amounts of information to control, and consequently, this influences firms to express their international position to stakeholders by improving disclosure.

The above considerations indicate an expected positive sign for both relations.

**H5:** There is a significant positive association between internationalisation level and the extent of mandatory and voluntary disclosure concerning biological assets.

**H6:** There is a significant positive association between listing status and the extent of mandatory and voluntary disclosure concerning biological assets.

- Profitability

Taking into consideration the agency theory (Jensen and Meckling, 1976), disclosure controls a manager's performance. Managers disclose detailed information in order to assure their compensation and position. Additionally, the signalling theory explains that, when the rate of return is high, firms are expected to disclose good news to prevent any reduction of their share value (Oliveira *et al.*, 2006).

Lan *et al.* (2013) and Chavent *et al.* (2006) have considered firm performance, measured by the return on equity, as a relevant explanatory variable for the disclosure level. Lang and Lundholm (1993:250) have noticed that "the results from theoretical and empirical research suggest disclosure could be increasing, constant, or even decreasing in firm performance". As an example, in case of negative earnings information, firms are more likely to disclose in order to reduce the possibility of legal liability.

Because of the mixed empirical evidence in prior literature, there is no strong expectation regarding the sign of this variable.

**H7:** There is an association between profitability and the extent of mandatory and voluntary disclosure concerning biological assets.

- Sector

Based on the signalling theory, it is expected that firms belonging to the same sector are concerned with assuring the same disclosure level in order to prevent an undesirable assessment by the market (Oliveira *et al.*, 2006). As a consequence, firms tend to be motivated to follow their corresponding sector practice (Amiraslani *et al.*, 2013). With regard to the legitimacy theory, and in response to stimulating requirements of IFRS reporting, firms may follow common industry practices to legitimise their performance (Glaum *et al.,* 2013).

In terms of mandatory disclosure, Rahman *et al.* (2002) have compared accounting regulations and accounting practices in Australia and New Zealand and have concluded that sector influences the disclosure level. In fact, "the nature of activities within an industry could also be a reason for the diversity in both the amount and type of disclosure and measurement practices among firms" (Rahman *et al.*, 2002:53).

The above considerations indicate an expected positive sign for the relation in: agriculture, forestry, fishing and mining sectors and in the manufacturing sector, as these are associated with biological assets.

**H8:** There is a significant positive association between sector and the extent of mandatory and voluntary disclosure concerning biological assets.

### 2.3.2. Country-level variable

A country-level variable, such as legal status, "may act as a summary measure for a country's approach to a number of regulatory issues and therefore could have significant explanatory power in regressions involving institutional (or country) variables" (Leuz, 2010:242). In this study, legal status is the only country-level variable and it is divided into two classifications as follows.

- Legal status

Considering the contingency theory, Doupnik and Salter (1995) have suggested that the external environment, the institutional structure and the cultural values support accounting divergence between countries. Furthermore, the institutional complementarities among countries imply the combination of institutional factors that are commonly detected (Leuz, 2010). Also, "classifying national accounting systems has long been an aspect of accounting research" (Nobes and Stadler, 2013:573).

Due to the diversity of country classifications, this essay adopts two approaches, namely: the dichotomy common law versus code law countries and cluster classifications. Regarding the first approach, firms that belong to common law countries are expected to converge to IFRS (Nobes, 2008) and to improve their accounting quality (La Porta *et al.*, 1998). In what it concerns to cluster classification, Leuz's (2010) cluster classification is adopted using regulatory and reporting practice variables. It consists of three clusters, as previously mentioned, namely: cluster 1 – outsider

economies, cluster 2 – insider economies with better legal enforcement systems, and cluster 3 – insider economies with weaker legal enforcement systems. Firms that belong to cluster 1 tend to show a higher disclosure level. Annex A presents Leuz's (2010) cluster classification.

Regarding the fact that disclosure practices under discussion in this study includes mandatory but also voluntary disclosure requirements of IAS 41 and, additionally, the recommended best practices by PwC (2011), above considerations indicate an expected positive sign for the relation in the following branches: common law and cluster 1.

**H9:** There is a significant positive association between firms that belong to common law countries and the extent of mandatory and voluntary disclosure concerning biological assets.

**H10:** There is a significant positive association between firms that belong to cluster 1 and the extent of mandatory and voluntary disclosure concerning biological assets.

The hypotheses, proxies and expected signals of independent variables introduced above are described in the table 2.1. Data were collected in DataStream.

The biological assets intensity (BIO) corresponds to a ratio between biological assets and total assets. Ownership concentration (HELD) is the ratio between the number of closely held shares (shares held by insiders) and the common shares outstanding (the most recent common shares outstanding available in the database, which relates to the difference between issued shares and treasury shares). Prior literature measures firm size (SIZE) in several different ways. In this essay, firm size corresponds to the logarithm of total assets. Auditor type (AUDIT) is a dummy variable coded 1 for clients of the Big 4 auditing firms and 0 otherwise. In 2011, the Big 4 auditors are PwC, Deloitte Touche Tohmatsu, Ernst and Young and KPMG. The internationalisation level (INT) corresponds to a ratio between foreign sales and total sales[4]. Listing status (STOCK) is a dummy variable coded 1 if the firm is listed on one foreign stock

[4] It is expected that firms internationalise by opening explorations in different countries. Probably, in this case, foreign sales are low because each exploration sells to the country where it is located. As a result, this variable could be measured, for example, by the number of countries where the firms are located (instead of the sales ratio adopted). Therefore, the sales by geographic segment variable was identified in DataStream (variable WS19601). This was tested for a sample of firms, considering the ratio between this variable WS19601 (selecting segments of foreign countries with the variable WS19600) and the net sales (variable WS01001), and the results were the same that are obtained by variable WS08731. Consequently, in this essay this is the adopted variable (variable WS08731).

exchange or multi-listing and 0 otherwise. Profitability (ROE) corresponds to the proxy return on equity. This is measured by the ratio between pre-tax income and common equity[5]. Sector (SECTOR) relates to SIC code classification (two-digit), namely: sector 1 – agriculture, forestry, fishing and mining (01-14), sector 2 – manufacturing (20-39), and other sectors.

**Table 2.1. Hypotheses, variable proxies and expected signals**

| Hypotheses | Variable proxies | Expected signals |
|---|---|---|
| Biological assets intensity | BIO – Biological assets (WS18277, WS18278, or WS18258) divided by total assets (WS02999) multiplied by 100 | Positive |
| Ownership concentration | HELD – Closely-held shares percentage (WS08021) | Negative |
| Firm size | SIZE – Logarithm of the total assets (WS02999) | Positive |
| Auditor type | AUDIT – Binary variable based on whether the firm is audited by a Big 4 auditing firm (WS07800) | Positive |
| Internationalisation level | INT – Foreign sales percentage (WS08731) | Positive |
| Listing status | STOCK – Binary variable based on whether the firm is listed in one or more than one foreign stock exchange (WS05427) | Positive |
| Profitability | ROE – Pretax income (WS01401) divided by common equity (WS03501) multiplied by 100 | No expected signal |
| Sector | SECTOR – Dummy variable based on whether the firm belongs to sector 1, 2 or others regarding SIC code classification (WS07021) | Positive |
| Legal status | LEGAL – Binary variable based on whether the firm belongs to a common law or code law country | Positive |
| | CLUSTER – Dummy variable based on whether the firm belongs to cluster 1, 2 or 3, regarding Leuz's (2010) cluster classification | Positive |

Finally, the legal status is measured by two proxies (LEGAL and CLUSTER). "A classification should be based on detailed observation of characteristics" and "the characteristics chosen should ideally be informed by the purpose of the classification" (Nobes and Stadler, 2013:584). Consequently, the LEGAL variable is computed based

[5] Instead of adopting WS08301 that corresponds directly to return on equity-total %, the purpose of using the ratio between pre-tax income WS01401 and common equity WS03501 was to neglect the tax effect.

on Nobes (2008), La Porta *et al.* (1998)[6] and corresponds to a binary variable coded 1 for firms that belong to a common law country, and 0 if firms belong to a code law country. The CLUSTER variable is computed based on Leuz's (2010) cluster classification regarding regulatory and reporting practice variables. This classification includes an earnings management and opacity score from Leuz *et al.* (2003), which has been emphasised by Nobes and Stadler (2013:582) as having "specified the purpose of their own attempts, apart from organizing knowledge". In case of the firms whose countries are not considered in Leuz's (2010) cluster classification, some of them were classified according to Amiraslani *et al.* (2013), who follow the same taxonomy, and a few other firms were classified based on the proximity of their countries to other countries included in the three clusters.

## 2.4. Methodology

### 2.4.1. Selection

To examine the potential associations between mandatory and voluntary disclosure of biological assets and firm and country-level determinants, with recent data, this essay explores disclosure by listed firms covering biological assets during 2011. Data were collected in DataStream. Firstly, countries were selected that adopted IFRS until 2010, to prevent possible biased data that could result from analysing the year of adoption in 2011, given the exemptions and exceptions allowed by IFRS 1. Then, considering the corresponding selection of countries, firms that have biological assets were selected. The criterion was to follow one of the biological assets variables (WS18277: biological assets – net book value; WS18278: biological assets – gross; WS18258: biological assets – current). The result was 282 firms from several countries and different sectors, but 12 of them do not have an available 2011 annual report, so the actual number of analysed firms was 270. When any of the proxies of the independent variables was not available in DataStream, there was an effort to obtain information in 2011 annual report to mitigate the effect of missing information in this study.

[6] To assure this classification in a few firms whose countries are not considered in both studies, it was used as source of information the World Factbook (CIA, 2015).

### 2.4.2. Disclosure index

In order to provide a disclosure measure for the present study, firstly and regarding voluntary disclosure, there are several papers that include both the extent and the quality-based analysis related to the corresponding topic of interest (Abraham and Shrives, 2014; Bellora and Guenther, 2013; Hooks and Van Staden, 2011; Van Staden and Hooks, 2007). According to Hooks and Van Staden (2011) the first analysis quantifies the extent of reporting on a specific issue using several measures such as words, sentences or pages and the second analysis evaluates the quality of the disclosures using a quality index. There are several limitations what it concerns the extent-based analysis. For example, Steenkamp and Northcott (2007) state that the researcher's role is crucial to establish what information is materialised from a content analysis; in spite of the focus being the text, it can be interpreted in several ways; also, the scope of the analysed text is delimited by its context. Marston and Shrives (1991) comment that there are repetitions of specific words in the annual reports and that firms also differ in the complexity of their operations, which allow to conclude that measuring information by counting numbers or words is not the ideal answer.

Considering mandatory disclosure and, for example, given compliance with goodwill impairment disclosures, Amiraslani *et al.* (2013) have concluded that there is an excessive use of boilerplate language combined with the wording restate related to the corresponding standard, exercising a minimum level of judgment. Furthermore, and with the purpose of mitigating these boilerplate disclosures, on 27th June 2013, at the IFRS Foundation conference, Hans Hoogervorst, the Chairman of the IASB, has encouraged to exclude nonmaterial disclosures relating to "less is often more" and to avoid the risk of annual reports turning into merely compliance documents, rather than means of communication (IFRS Foundation, 2013b).

Given the previous clarification and the fact that more disclosure could not be synonymous of higher disclosure quality, the present study adopts a quality-based analysis. Therefore and based on prior research (Lan *et al.*, 2013; Santos *et al.*, 2013; Lopes and Rodrigues, 2007; Oliveira *et al.*, 2006; Akhtaruddin, 2005; Owusu-Ansah, 1998; Inchausti, 1997), this essay includes a disclosure index as a dependent variable. Concerning to biological assets, Scherch *et al.* (2013), Silva *et al.* (2012), Theiss *et al.* (2012) adopted this approach within Brazilian context.

The index is built based on the disclosures required by IAS 41 and calculated with the notes to the consolidated financial statements included in 2011 annual report of this selection of firms[7]. "Although there are several ways of communicating company information, such as interim reporting, press releases, letters, etc., the annual report is still considered the major medium disclosing information" (Akhtaruddin, 2005:407).

This index includes three categories: mandatory items, non-mandatory but recommended items and non-mandatory and non-recommended items. The first and the second classifications cover all disclosure items required by IAS 41. The last category concerns voluntary information indicating that firms have exceeded IAS 41 disclosure requirements. Actually, "an index can include a mixture of items required by regulation and voluntary items if this suits the purpose of the research project" (Marston and Shrives, 1991:195). Given the intrinsic complexity of biological assets fair valuation, non-mandatory and non-recommended items are only applicable to firms that measure biological assets at fair value. This third classification is constructed according to PwC (2011). Three topics are identified as being followed by their clients in disclosure practices, where the timber sector is concerned, namely: revealing the complexity of various parameters regarding the effect on the valuation (but there is limited information regarding the effect on the valuation); providing more information on the effects of variations in key factors; exposing assumptions on future prices and costs, as well as disclosing a sensitivity analysis with multiple parameters. The items selected for inclusion in the disclosure index and the results are shown in Appendix A.

Based on the literature about this research topic (Santos *et al.*, 2013; Lopes and Rodrigues, 2007; Owusu-Ansah, 1998), the disclosure index is dichotomous, unweighted and adjusted for non-applicable items. Firstly, a score of 1 is assigned to an item if it is disclosed, and a score of 0 otherwise, which means that the index is dichotomous. The maximum number of items is 40. Secondly, each item is equally important for all three categories. Although a weighted index permits some dissimilarities, given the relative importance of certain items of information (Inchausti, 1997), here the assumption is that an unweighted approach will result in a minor bias, because the effort of the index relies in all three categories. Finally, the index follows a

[7] The analysis of the annual reports was performed by one researcher. In order to assure robustness of the index calculation and to minimise possible coding bias, the researcher coded the information twice and any discrepancies were solved.

tolerant criterion (Santos *et al.*, 2013) and covers the applicability of any item to each firm. It excludes the items when there is no information in the notes to the consolidated financial statements about one disclosure item of IAS 41. In this sense, adopting an adjusted index neglects the effect if the selected firms measure biological assets at fair value or at historical cost. There is only one exemption regarding the last attribute, the following item of IAS 41 [IAS 41.49]: "financial risk management strategies related to agricultural activity". Risk strategy related to biological assets is highly important in the sense that a firm is required to declare the overall strategy in the annual report. Therefore, if this item contains no information it is considered in the index as a non-disclosed item. In fact, "disclosure may not be purely an economic decision, particularly when social and political aspects also need to be considered" (Abraham and Shrives, 2014:93).

The total score of the mandatory and voluntary disclosure index for biological assets (Index) in a firm is:

$$Index_i = \frac{\sum_{i=1}^{m} d_i}{m} \tag{2.1}$$

where $d_i = 0$ or 1, as follows: $d_i = 1$ if the item is disclosed and $d_i = 0$, otherwise; $m$ = maximum number of applicable items a firm may disclose.

Finally, the index follows two criteria, namely, reliability and validity, supported by Marston and Shrives (1991). It is reliable in the sense that the results can be replicated by another researcher and it is valid in the sense that it serves the purpose of the research.

## 2.5. Results

### 2.5.1. Descriptive analysis

Table 2.2 presents the descriptive statistics for the variables employed in the study. There is a wide range in the disclosure index (INDEX) in the selection: the highest disclosure score obtained is 100 and the lowest is 0. Appendix B presents the 10 selected firms that have higher and lower disclosure level with the corresponding country and sector. The mean disclosure score is 56.55 (median=59.00).

The average biological assets intensity (BIO) is 11.65% but the median is less than 4.52% and this variable lists a maximum of 95.38%. The firm size (SIZE) mean is 13.02% (median=12.87%) and registers a maximum of 17.84%.

In terms of ownership concentration (HELD), internationalisation level (INT) and profitability (ROE), even though some observations are collected in annual reports when the DataStream has no information, these are the independent variables with more missing values (n=228, 221 and 256, respectively). With regard to profitability, 9 observations were removed because they were identified as outliers.

**Table 2.2. Descriptive statistics**

| **Selection: 1 270** | **Mean** | **Median** | **Maximum** | **Minimum** | **Std. Dev.** | **Skewness** | **Observ.** |
|---|---|---|---|---|---|---|---|
| INDEX | 56.55 | 59.00 | 100.00 | 0.00 | 20.90 | -0.43 | 270 |
| BIO | 11.65 | 4.51 | 95.38 | 0.0(1) | 16.65 | 2.35 | 270 |
| HELD | 54.32 | 60.22 | 99.74 | 0.01 | 28.24 | -0.43 | 228 |
| SIZE | 13.02 | 12.87 | 17.84 | 7.27 | 1.86 | 0.07 | 270 |
| INT | 46.00 | 40.59 | 100.00 | 0.00 | 38.60 | 0.11 | 221 |
| ROE | 8.58 | 9.77 | 52.02 | -57.20 | 16.39 | -0.68 | 256 |
| | | | | | **Frequency** | **Percent** | **Index** |
| AUDIT | Firm audited by a Non- Big 4 auditing firm | | | | 72 | 26.67 | 56.00 |
| | Firm audited by a Big 4 auditing firm | | | | 198 | 73.33 | 57.00 |
| STOCK | Firm not listed on any foreign stock exchange | | | | 214 | 79.26 | 56.00 |
| | Firm listed on one foreign stock exchange or multi-listing | | | | 56 | 20.74 | 58.00 |
| SECTOR | Agriculture, forestry, fishing and mining | | | | 86 | 31.85 | 60.00 |
| | Manufacturing | | | | 150 | 55.56 | 57.00 |
| | Others | | | | 34 | 12.59 | 46.00 |
| LEGAL | Common law | | | | 107 | 39.63 | 59.00 |
| | Code law | | | | 160 | 59.26 | 55.00 |
| | No label | | | | 3[8] | 1.11 | 48.00 |
| CLUSTER | Cluster 1 | | | | 103 | 38.15 | 58.00 |
| | Cluster 2 | | | | 97 | 35.93 | 58.00 |
| | Cluster 3 | | | | 58 | 21.48 | 53.00 |
| | No label | | | | 12[9] | 4.44 | 50.00 |

In terms of dummy variables, the previous table provides the average disclosure index for each variable. The majority of the selection of firms (73.33%) is audited by a

[8] These firms represent the countries Cyprus, Mauritius and United Arab Emirates. Regarding the World Factbook (CIA, 2015), these countries have a mixed classification: Cyprus and Mauritius correspond to common law/civil law and United Arab Emirates corresponds to muslim law/civil law.

[9] These firms represent the countries Cayman Islands, Croatia, Cyprus, Kuwait, Mauritius, Oman, Russian Federation, Ukraine and United Arab Emirates. These countries are not included in Leuz's (2010) cluster classification. Furthermore, there is no additional information that supports a plausible classification.

Big 4 auditing firm (AUDIT), only 20.74% corresponds to firms that are listed in one foreign stock exchange or multi-listing (STOCK) and the average disclosure index is almost the same for both variables, about 57. Taking into consideration the sector, 31.85% of the selected firms relates to agriculture, forestry, fishing and mining represents the highest average disclosure index of 60 (SECTOR). The frequency of sector "Others" is presented in Appendix C.

Finally, considering legal status (LEGAL), 59.26% corresponds to the firms that belong to a code law country and the selection is relatively homogenous in terms of cluster classification (CLUSTER). Once again, there are no significant differences in the average disclosure indexes.

Appendix A summarises, by disclosure item, the number of firms that disclose biological assets information. The most frequently reported items are: "A reconciliation of changes in the carrying amount of biological assets between the beginning and the end of the period" (n=248; [IAS 41.50]); "This reconciliation includes desegregation" (n=242; [IAS 41.50]); and "A description of each group of biological assets" (n=230; [IAS 41.41]). This evidence is consistent with prior literature (Silva *et al.*, 2012) for Brazilian firms. The least reported items are: "The range of estimates within which fair value is highly likely to lie" (n=2; [IAS 41.54]), when the entity measures biological assets at their cost less any accumulated depreciation and any accumulated impairment losses; and "Unfulfilled conditions and other contingencies attaching to government grants" (n=1; [IAS 41.57]).

In the overall, these findings suggest that there is an opportunity for improving biological assets disclosure, as concluded by PwC (2011) for the timber sector. Additionally, Appendix D presents the ranking of countries by the number of firms and their average disclosure level.

Pearson's correlation matrix between all variables is shown in table 2.3. The dependent variable is positively correlated to biological assets intensity at 1% level of significance.

It is commonly established that correlations between independent variables are not risky in multivariate analysis unless they exceed 0.80 or 0.90 (Gujarati, 1995). Since there are no highly correlated independent variables, all variables are maintained in the model.

**Table 2.3. Pearson's correlation**

| | INDEX | BIO | HELD | SIZE | INT | ROE |
|---|---|---|---|---|---|---|
| INDEX | | | | | | |
| BIO | 0.428*** | | | | | |
| HELD | 0.118 | -0.009 | | | | |
| SIZE | 0.001 | -0.121* | -0.230*** | | | |
| INT | 0.053 | 0.163** | -0.090 | 0.268*** | | |
| ROE | 0.086 | 0.091 | -0.006 | 0.231*** | 0.036 | |

Statistical significance at: *** 1% level; ** 5% level; * 10% level

The table demonstrates that firm size is negatively correlated to biological assets intensity and ownership concentration at 10% and 1% level of significance, respectively and positively correlated to internationalisation level and profitability at 1% level of significance. Finally, biological assets intensity is positively correlated at 5% level of significance with internationalisation level.

### 2.5.2. OLS regression model

Regarding the following OLS regression model, two equations are considered for the country-level determinant. The results are provided in table 2.4. In both regressions, the presence of heteroscedasticity is analysed with White's general test (White, 1980). This test indicated the presence of heteroscedasticity in both regressions; as a result, both equations are re-estimated, adjusting the standard errors for heteroscedasticity.

$$Index_i = b_0 + b_1 BIO + b_2 HELD + b_3 SIZE + b_4 AUDIT + b_5 INT + b_6 STOCK + b_7 ROE + \\ + b_8 \sum_{j=1}^{j=3} SECTOR_j + b_9 LEGAL + u_i \quad (2.2)$$

$$Index_i = b_0 + b_1 BIO + b_2 HELD + b_3 SIZE + b_4 AUDIT + b_5 INT + b_6 STOCK + b_7 ROE + \\ + b_8 \sum_{j=1}^{j=3} SECTOR_j + b_9 \sum_{l=1}^{l=3} CLUSTER_l + u_i \quad (2.3)$$

Table 2.4 presents the estimation results. Mandatory and voluntary disclosure is statistically positive related to biological assets intensity, firm size, sector (agriculture, forestry, fishing, mining and manufacturing), to belong to a common law country and to the cluster 1 and surprisingly to ownership concentration, as explained below. This table assures the feasibility of the regression model by explaining the mandatory and voluntary disclosure with an adjusted R-squared of 0.215 that increases in the second equation to 0.235.

Regarding the firm-level determinants on mandatory and voluntary disclosure of biological assets, the finding related to biological assets intensity is consistent with Scherch *et al.* (2013) and also with other non-financial assets, for example goodwill impairment (Amiraslani *et al.*, 2013; Glaum *et al.* 2013; Heitzman *et al.*, 2010; Shalev, 2009) and provisions (Chavent *et al.*, 2006). Concerning firm size, this finding is consistent with prior literature (Amiraslani *et al.*, 2013; Glaum *et al.*, 2013; Lan *et al.*, 2013; Oliveira *et al.*, 2006; Depoers, 2000).

**Table 2.4. OLS regression model**

| **Equation:** | **(2.2)** | | **(2.3)** | |
|---|---|---|---|---|
| Selection: | 1 269 | | 1 269 | |
| Included observations: | 187 after adjustments | | 180 after adjustments | |
| Dependent variable: | INDEX | | INDEX | |
| Variable | coefficient | t-statistic | coefficient | t-statistic |
| Constant | 9.117 | 0.632 | 11.943 | 0.787 |
| BIO | 0.704 | 4.161*** | 0.781 | 4.202 *** |
| HELD | 0.118 | 2.212** | 0.114 | 2.196** |
| SIZE | 1.873 | 1.881* | 1.646 | 1.611* |
| AUDIT | -0.989 | -0.271 | -1.116 | -0.286 |
| INT | -0.036 | -0.992 | -0.026 | -0.693 |
| STOCK | -4.523 | -1.192 | -4.833 | -1.221 |
| ROE | 0.017 | 0.187 | 0.005 | 0.049 |
| SECTOR1=1 | 13.462 | 2.920*** | 10.738 | 2.456** |
| SECTOR2=1 | 11.249 | 2.591** | 10.112 | 2.482** |
| LEGAL | 5.451 | 1.821* | | |
| CLUSTER1=1 | | | 6.679 | 1.681* |
| CLUSTER2=1 | | | 1.956 | 0.514 |
| R-squared | 0.257 | | 0.282 | |
| Adjusted R-squared | 0.215 | | 0.235 | |
| S.E. of regression | 18.600 | | 18.060 | |
| F-statistic | 6.089*** | | 5.985*** | |
| Wald F-statistic | 3.816*** | | 3.508*** | |

Statistical significance at: *** 1% level; ** 5% level; * 10% level

Taking sector into consideration, Amiraslani *et al.* (2013) have concluded that the oil and gas sector reveals a high level of compliance in the impairment-intensive sector. In this essay, considering equation (2.2) on average and other parameters being equal, firms in sector 1 (agriculture, forestry, fishing and mining) and sector 2 (manufacturing) exhibit a disclosure level, which is, respectively, 13.46% and 11.25% higher than the disclosure level of firms that belong to other sectors, (and considering equation (2.3),

the results are 10.74% and 10.11%, respectively, with the same sign). This finding is consistent with the fact that these sectors are associated with biological assets. On the subject of ownership concentration, Depoers (2000) rejects the influence of this variable on voluntary disclosure in the French context. Also, Rahman *et al.* (2002) have compared accounting regulations and accounting practices in Australia and New Zealand and revealed that although ownership concentration does not seem to be related to mandatory disclosure, exhibits a positive sign related to voluntary disclosure.

Furthermore, the relation between mandatory and voluntary disclosure and the type of auditor, internationalisation level, listing status and profitability, is not supported by the results. Regarding the type of auditor, this result is probably related to the fact that the majority of the firms are audited by a Big 4 auditing firm, and so the variable has little explanatory power. Regarding the negative sign, Lan *et al.* (2013) have analysed the voluntary disclosure determinants of Chinese listed firms and have suggested that probably the firms audited by the Big 4 auditing firms kept more attention than other firms and tend to disclose more information through other means, such as media. Also, and regarding biological assets disclosure, Elad and Herbohn (2011:116) have concluded that "notwithstanding this low level of compliance none of the companies received a qualified audit opinion due to insufficient disclosure. Presumably, the auditors adopted a flexible approach that recognises the salience of each item and the individual circumstances of each company when assessing the adequacy of disclosure". Bearing in mind internationalisation level, Oliveira *et al.* (2006) have also rejected that the extent of voluntary disclosure of intangibles information is positively related to the internationalisation of the firm, which was measured by the same variable. In what it concerns with listing status, even though Oliveira *et al.* (2006) have concluded that this variable explains the extent of voluntary disclosure of intangibles information, it is verified to a lesser extent when compared to other factors. Amiraslani *et al.* (2013) state that this variable is not considered a significant determinant of compliance with goodwill impairment disclosure. Finally and considering profitability, Chavent *et al.* (2006) have investigated the 2011 annual report of 100 French firms that integrate the *Société des Bourses Françaises* (SBF) 120 stock index and found that the disclosure pattern is not associated with return on equity. In addition, Wallace and Naser (1995) have investigated firm-specific determinants of the comprehensiveness of mandatory

disclosure in the corporate annual reports of listed firms in the Hong Kong stock exchange and have concluded that return on equity was less useful to explain variation in disclosure indexes. A possible explanation is that "reporting firms in HK tend to view lower profit margins as bad news and probably accept the provision of more details as part of their accountability to investors and other users of CARs (corporate annual reports)" (Wallace and Naser, 1995:346).

Considering the country-level determinants on mandatory and voluntary disclosure of biological assets, the results of the LEGAL variable corroborate the theoretical background (La Porta *et al.*, 1998). With regard to the CLUSTER variable, this result is confirmed by Amiraslani *et al.* (2013), who state the cluster 1 underlies the strong effect of an outside economy where IFRS compliance is concerned.

## 2.6. Conclusions, limitations and suggestions for future research

This chapter examines the disclosure level by listed firms on biological assets and the impact of firm and country-level determinants on mandatory and voluntary disclosure of biological assets.

Firstly, even though the majority of disclosure items are mandatory, the index stands in a wide range of values. Frequently firms disclose the reconciliation of changes of biological assets between the beginning and the end of the period with desegregation and tend to avoid the requirement of disclosing the range of estimates of fair value. Then and considering stakeholder, agency and signalling theories, the firm-level determinants, namely: biological assets intensity, firm size and to belong to agricultural and manufacturing sectors have a significant positive impact on mandatory and voluntary disclosure practices. Surprisingly, ownership concentration has also a significant positive impact on mandatory and voluntary disclosure practices. Taking into consideration country-level determinants supported by contingency theory, the results corroborate the theoretical background. Firms that belong to common law countries or to outsider economies improve the extent of the mandatory and voluntary disclosure of biological assets.

There are some limitations to this study. Firstly, because there was only one researcher involved in this research, inter-coder reliability cannot be guaranteed concerning the construction of the disclosure index used to measure the disclosure level

of biological assets. For example, there are no defined rules to deciding which paragraphs of IAS 41 should be grouped and which should represent one index item, as well as deciding if an item is applicable to a specific firm or not, so the information was treated according to the researchers' best judgment. To minimise possible coding bias, the researcher coded the information twice and any discrepancies were solved. Secondly, this study focuses on the impact of specific firm determinants over disclosure practices, but there are maybe other relevant variables to consider, such as leverage.

Future research on this area could also follow other classifications regarding firms or countries. Furthermore, it could be analysed how the impact of environmental regulations at the country-level influences firms' incentives to disclosure information with respect to IAS 41.

In spite of these limitations, this research brings important contributions to the literature in this area. This essay has extended the studies to a worldwide selection, assuring that a larger number of countries and determinants with recent data are included. This study is particularly useful to standard setters since IAS 41 was recently under an ongoing project for review. In addition, this work has several implications for different users. Firstly it promotes awareness among accounting regulators concerning the disclosure requirements constraints of biological assets, which relate to smaller firms and firms where biological assets do not represent the core business. Moreover, stakeholders of small firms also benefit once they recognise that there is less disclosed information. Finally, all other stakeholders benefit because they will be aware of disclosure level and its determinants.

# CHAPTER 3

# Accounting for Biological Assets:

# Measurement practices of listed firms

## 3.1. Introduction

IAS 41 deals with the concept of "living assets", which represents the singular characteristic of natural biological growth that historical cost valuation is unable to manage (Herbohn *et al.*, 1998). As a basic rule, this standard requires biological assets to be measured at fair value less costs to sell on initial recognition and at subsequent reporting dates.

This severe change from traditional historical cost model (Oliveira *et al.*, 2015; Elad and Herbohn, 2011; Lefter and Roman, 2007) has been responsible for the debate on agricultural accounting (Argilés *et al.*, 2011). IAS 41 has been also censured for being excessively theoretical and for presenting unsuitable measurement methods for biological assets (Herbohn and Herbohn, 2006). Moreover, Aryanto (2011) has claimed that the accretion concept in IAS 41 is overgeneralised, which means that this standard establishes the same treatment for all biological assets. In the particular case of bearer biological assets the corresponding fair value is very difficult to achieve due to the absence of an active market, as previously mentioned. There are also other factors, namely: difficulty to detect attributes of bearer plants; incurred costs related to the fair value estimate that outweighs the benefits; earnings volatility and misleading; as well as the lack of relevant information and knowledge (Muhammad, 2014; Aryanto, 2011).

Furthermore, the single exception allowed to fair value measurement is only applied to initial recognition and in a particular context: a market-determined price is not available and the entity cannot assure a reliable estimate of fair value [IAS 41.30]. In such conditions, the entity uses the unreliability clause of fair value and measures the biological assets at cost less depreciation and impairment.

At first glance, and regarding the obligation of IAS 41 to measure biological assets at fair value, it may seem less reasonable to analyse it as a matter of choice. "We expect companies to use fair value measurement when required to do so by accounting standards. That is, we expect companies to comply with the mandatory fair value measurement requirements in IAS 39, IAS 41 and IFRS 2. Large companies (as included in this study) have both the available resources and necessary incentives to comply with accounting standards" (Cairns *et al.*, 2011:7). Subsequently, if there are firms that use the unreliability clause of fair value, ideally this should mean that firms are unable to report biological assets at fair value. However, and according to some

literature, it seems that there are other reasons related to firm and country environment that could explain the adoption of historical cost, even when the clause does not apply (Taplin *et al.*, 2014; Christensen and Nikolaev, 2013; Guo and Yang, 2013; Hlaing and Pourjalali, 2012; Elad and Herbohn, 2011; Fisher *et al.*, 2010; Quagli and Avallone, 2010; Daniel *et al.*, 2010; Muller *et al.*, 2008; Elad, 2004). Therefore, to this extent, this research is developed under the accounting choice theory.

On one hand, previous literature concerning the cultural and institutional impacts of IAS 41 in accounting harmonisation in agriculture (Elad and Herbohn, 2011) has revealed that Anglo-Saxon countries have a straight relationship with this standard and are receptive to fair value measurement. For example, Fisher *et al.* (2010) have analysed the adoption of IAS 41 in New Zealand (classified as a common law country) and have concluded that listed firms operating in the agricultural sector follow fair value, even when there is no active market. Consequently, it seems that fair value measurement is not a problem in this country. In Continental Europe, historical cost is the mainstream method (Elad, 2004).

On the other hand, and due to the lack of studies concerning measurement determinants of biological assets, this study has relied on literature related to this discussion topic for other non-financial assets, such as investment property, plant, property and equipment. As far as non-financial assets are concerned, in general, larger firms, which are more leveraged, and have more non-financial assets and higher expertise in fair value measurements, tend to choose the option of fair value accounting (Daniel *et al.*, 2010). With regard to investment property, fair value is preferred when this measure tends to improve performance measurement (Christensen and Nikolaev, 2013), also information asymmetry, contractual efficiency and managerial opportunism are factors that explain the adoption of fair value (Quagli and Avallone, 2010).

In addition, in June 2014, IASB has approved the adjustment in IAS 41 that allows firms to choose either the cost or the revaluation models for mature bearer plants according to IAS 16 – Property, plant and equipment, for annual periods beginning on or after 1 January 2016. Within the context of the corresponding project settled by IASB, Muhammad (2014) has proposed to develop a study in Malaysia in order to identify the factors that influence bearer biological assets, and consequently establish a fair value model. Chief executive officers, accountants and managers linked to firms

that have bearer biological assets are the respondents of this study, due to their expertise and knowledge on this subject.

Taking into account the measurement practices of biological assets and other non-financial assets as documented in previous literature, the aim of this chapter is to explore the following research question:

- What firm and country-level determinants explain the differences in practices used to measure biological assets among listed firms?

In order to address this question, this study establishes several hypotheses that relate the measurement practices of biological assets with firm and country-level determinants. To identify if the firms measure biological assets at fair value or claim for the allowed exception and measure biological assets at historical cost, the study analyses the notes to the consolidated financial statements included in the 2012 annual report of a worldwide selection composed of 324 firms from 33 IFRS adopting countries. Appendix E exhibits the number of firms by country with the related measurement practice. Bearing in mind previous studies, this essay provides a broader research as it considers a larger number of countries and determinants with recent data.

The study is structured as follows: Section 3.2 provides a literature review, firstly by focusing on the debate of measurement requirements of IAS 41, and then by discussing the influence of firm and country-level determinants. Section 3.3 introduces the hypotheses. Section 3.4 describes the methodology and presents the selection. Section 3.5 discusses the findings from the empirical analysis. Finally, the chapter provides a brief conclusion.

## 3.2. Literature review

### 3.2.1. Measurement requirements of IAS 41

The choice between fair value and historical cost accounting is one of the most extensively discussed subjects in the literature (Hail *et al.*, 2010; Laux and Leuz, 2010). In the particular case of biological assets the constraints of implementing the IAS 41 related to fair valuation have been investigated by various authors (Gabriel and Stefea, 2013; Elad and Herbohn, 2011; Argilés *et al.*, 2009; George, 2007; Herbohn and Herbohn, 2006; Argilés and Slof, 2001).

Firstly, as mentioned before, Elad and Herbohn (2011) have demonstrated a high level of agreement where the costs of measuring biological assets at fair value outweigh the corresponding benefits. This is the particular case of plantation firms in which the fair value of tropical crops such as rubber trees, oil palm and tea can only be ascertained at excessive costs. Additionally, their study covers a wide-range of biased fair value estimates and suppositions that could imply different results. Elad and Herbohn (2011) argue that there is a need for IASB to revisit IAS 41. Another concern is the apparent need for the auditor to write an audit report about the firms' financial statements that claim "the reader's attention to inherent uncertainties regarding the valuation of biological assets under IAS 41" (Elad and Herbohn, 2011:107). As a matter of fact, in some cases, auditors and managers collide in disagreement.

Additionally, Herbohn and Herbohn (2006) have evaluated the impact of IAS 41 in the forestry sector of the accounting standard AASB (Australian Accounting Standards Board) 1037 – Self-generating and regenerating assets, in Australia, as well as the methods of forestry valuation. They have highlighted the subjectivity of fair value measurement and the volatility of results related to unrealised gains and losses that are recognised in the income statement. There is a question that remains not answered: "do such accounting procedures (fair value measurement) reflect the nature of investment in forestry" (Herbohn and Herbohn, 2006:175)?

Furthermore, Gabriel and Stefea (2013) argue that IAS 41 must be carefully analysed according to the impact of production forecast in accounting, to the impact of fair value measurement over cash flows, and also to the possibility for firms to use accounting in their own interests. Firstly, given the fact that crop production depends on climatic conditions, the relevant fair value that is achieved today given specific assumptions could not be any more the same on the day after. Secondly, the fair value changes along different periods could imply recognition of gains, and overall, it could determine a loss at the point of harvest. Finally, with regard to the diversity of fair valuation models, managers could choose a specific measurement in order to serve their own interests.

In order to exemplify such limitations, George (2007), Director of the SIPEF Belgian group (international agro-industrial conglomerate), states that, nowadays, instead of historical cost, there is a permeable concept of fair value, which impacts on accounting information and difficults auditing opinion. Actually, Deloitte, SIPEF's auditing firm

draws attention of financial users to the uncertainty caused by the fair value adoption. Consequently, SIPEF isolates such effect, in the financial statements, so that the potential investor can analyse the results before and after fair value adoption.

In spite of previous contributions, Argilés *et al.* (2009) have concluded that fair valuation does not imply gain volatility, and assure a higher predictive power of future results. They have analysed the impact of using fair value in biological assets in Spain, considering a sample of about 500 Spanish firms from the agricultural sector. Therefore, fair valuation allows the manager to anticipate financial problems. Also, the improvement in results precision mitigates agency problems, as managers are perceived even more as specialised accountants.

In addition to measurement requirements of IAS 41, there are other motivations, namely firm and country-level determinants that support fair valuation on biological assets, which are shown in the next sub-section.

### 3.2.2. Influence of firm and country-level determinants

Due to the lack of studies on firm-level determinants of biological assets measurement, this study has relied on literature where the topic of examining these determinants – that explain the differences in measurement practices among listed firms, is discussed for other non-financial assets (Taplin *et al.*, 2014; Christensen and Nikolaev, 2013; Hlaing and Pourjalali, 2012; Quagli and Avallone, 2010; Daniel *et al.*, 2010; Muller *et al.*, 2008), such as investment property and plant, property and equipment. Table 3.1 summarises the analysed papers. They have in common some of the determinants that explain the adoption of fair value for non-financial assets and also the applied methodology, the binary models, with logistic regressions (the only exception is the study of Hlaing and Pourjalali (2012) that includes a probit regression).

Taking in to consideration country-level determinants, there are some international studies that deal with the influence of the country origin on biological assets measurement (Guo and Yang, 2013; Elad and Herbohn, 2011; Fisher *et al.*, 2010; Elad, 2004). In general, common law countries in opposite from code law countries tend to apply in a large extent fair value to biological assets.

**Table 3.1. Firm-level determinants**

| Paper | Assets | Selection | Variables | Main conclusions |
|---|---|---|---|---|
| Taplin *et al.* (2014) | Investment property | 96 listed firms (randomly selected) China 2008 | Leverage (book value of total liabilities divided by book value of total assets)<br>Listing status (dummy variable coded 1 if the firm is internationally listed)<br>International revenue (dummy variable coded 1 if the firm reports revenue from international sources)<br>Earnings management (ratio of the standard deviation of operating income divided by the standard deviation of cash flow from the operation)<br>Ownership concentration (% of shares outstanding that are held by directors) | Less evidence supports the usage of fair value model for firms with higher leverage.<br>Listed firms overseas, with international operations and higher volatility of reported earnings are more likely to use fair value model.<br>Firms with more dispersed ownership tend to adopt fair value in order to reduce information asymmetry. |
| Christensen and Nikolaev (2013) | Investment property | 275 firms The United Kingdom, Germany 2005 | Country (dummy variable coded 1 if the firm is domiciled in this country)<br>CountrySic65 (dummy variable coded 1 if the firm has SIC code 65 (real estate) among its first five SIC code classification)<br>Leverage (total liabilities divided by market value of assets) | Fair value adoption is influenced by:<br>Institutional differences;<br>Measure's ability to improve firm performance (which is related to how an asset is used, to hold or to trade it).<br>The cost of calculating fair value, conversely related to the asset's liquidity, is the main reason for managers to avoid fair value. |
| Hlaing and Pourjalali (2012) | Property, plant and equipment | 232 firms The United States of America 2004-2007 | Size (logarithm of the total assets)<br>Tangibility (ratio of total net property, plant and equipment to total assets)<br>Leverage (ratio of long-term debt to total assets) | Larger firms, with higher ratio of the total amount of property, plant and equipment to total assets are more likely to use the fair value model.<br>Non-financial assets can be revaluated under manager discretion, in order to influence investors' decisions, and for that reason, the reliability of this measurement is controversial. |

| Paper | Assets | Selection | Variables | Main conclusions |
|---|---|---|---|---|
| Quagli and Avallone (2010) | Investment property | 76 firms<br>Finland, France, Germany, Greece, Italy, Spain, Sweden<br>2005-2007 | Size (logarithm of the total assets)<br>Leverage (debt to asset ratio)<br>Market-to-book value (market-to-book ratio)<br>Earnings smoothing (dummy variable coded 1 if the firm has an earnings smoothing index higher than the average index of earnings smoothing in firm's country of domicile) | Contractual efficiency, information asymmetry and managerial opportunism are determinants of fair value.<br>As proxies of contractual efficiency, size reduces the fair value choice and leverage seems not to influence it.<br>Market-to-book ratio and earnings smoothing measure information asymmetry and managerial opportunism, respectively; both influence fair value choice negatively. |
| Daniel *et al.* (2010) | Non-financial assets | Chief Financial Officers (CFO)<br>U.S. public firms<br>2008 | Size (logarithm of the market value of equity)<br>Tangibility (ratio of the property, plant and equipment to total assets)<br>Expertise (measured as level 2 and level 3 assets scaled by total assets – both valuations for assets and liabilities, further explained in next sub-section, are more difficult and costly, given the absence of liquid markets)<br>Leverage (long-term debt divided by total equity) | Larger firms; higher ratio of non-financial assets to total assets; higher expertise in fair value measurements; and more leveraged firms are determinants of fair value for non-financial assets.<br>Fair value adoption is related to the corresponding benefits and costs: this trade-off could be reflected in the cost of equity or debt capital of the firm and consequently could assure a better firm performance. |
| Muller *et al.* (2008) | Investment property | 77 real estate firms<br>Continental Europe<br>2004-2006 | Tangibility (ratio of the investment property to total assets)<br>Ownership concentration (% of the stock held by insiders of the firm)<br>International operations (% of the revenue generated from operations outside of the firm's country of domicile)<br>IFRS adoption indicator (dummy variable coded 1 if the firm adopts IFRS voluntarily prior to the mandatory adoption effective 2005) | Fair value has been adopted for investment property, prior to IAS 40 mandatory adoption, when there was a higher investor demand for this information and also a larger commitment to assure financial reporting transparency.<br>Evidence suggests that market participants distinguish diversity in the quality of fair value disclosure, even when this practice is followed under a required standard. |

On the whole, according to Elad and Herbohn (2011), French firms follow historical cost valuation in biological assets, claiming that the fair value clause is unreliable. In contrast, in the United Kingdom and Australia, firms tend to adopt fair valuation, and in the case of bearer plants they involve independent external appraisers to calculate the present value of future net cash flows in biological assets. To some extent, the study supports that the cultural gap between these countries can explain the different accounting treatment.

Taking into account another example of a common law country such as New Zealand, Fisher *et al.* (2010) have identified three main problems for financial report preparers, namely: the divergence between NZ IAS 41 and the traditional accounting framework; income recognition and measurement reliability given the absence of active markets for some biological assets. This study has highlighted that from listed firms, where the agricultural sector includes biological assets for which there was no or limited active markets, none have applied historical cost. This may suggest that fair valuation in this context does not appear to be a problem.

Another international study concerning IAS 41 is developed by Elad (2004), which has provided a worldwide comparison between Europe, Africa and Australia. The study has concluded that fair value is more suitable than historical cost to those biological assets that have an active market, and more comprehensible to users of the information. African countries seem not to apply fair value, and Australian countries are followers of fair value, although they have identified a large volatility related to the fair valuation of biological assets.

Finally and regarding a peculiar country as China, Guo and Yang (2013) argue that the factors that affect biological assets measurement are the comprehensiveness of the assets' nature, the market environment and the balance between relevance and reliability of accounting information. Although the existence of a mature market and regulatory environment is suitable for fair valuation, it could also motivate performance manipulation. Currently, in this country the historical cost is desirable when compared to fair value. China should take hybrid measurement attributes in biological assets. Also, as markets become more mature and active, it is expected that fair value will replace historical cost.

## 3.3. Development of hypotheses

Based on previous studies, this essay focuses on the following research question:

- What firm and country-level determinants explain the differences in practices used to measure biological assets among listed firms?

Before explaining the hypotheses and in order to bring awareness to the selected firms of this study and ascertain any particular behaviour, the relationship between the measurement practice (fair value or historical cost) and the type of biological assets is tested with the chi-squared test (Greene, 2012). According to IAS 41, biological assets could be divided into bearer biological assets and consumable biological assets. Based on the 2012 annual report of the selected 324 listed firms, it was possible to identify the type of biological assets in each firm.

Given the chi-squared test results presented in Appendix F, overall, biological assets and the measurement policy adopted by firms are related. Thus and based on the previous classification, namely, bearer biological assets and consumable biological assets, the selection was split and submitted under the same approach. The results allow concluding that although consumable biological assets and their measurement policy are also related, the same does not apply to bearer biological assets. In this case, both variables are independent. Since the bearer biological assets are more complex to measure due to the lack of active markets, this absence of relationship could lead to a higher propensity to follow the unreliability clause of fair value or even cause a higher discretionary managers' behaviour. Consequently, it seems that there are other reasons that could support the measurement practices of bearer biological assets.

Conceptually, several theories can explain measurement practices. In this study, accounting choice and agency theories support firm-level determinants and the contingency theory supports country-level determinants.

In accordance with previous chapter, considering only two specific segments (country and firm) is supported by Luft and Shields (2014:555) that "reducing the number of plausible alternatives through narrow specification often contributes to the effectiveness and efficiency of research design."

The research model includes a binary dependent variable that corresponds to the measurement practice (one, if the firm measures biological assets at fair value; zero, if

the firm measures biological assets at historical cost), and explores several determinants that are expected to be related to the measurement of biological assets, namely, firm-level variables – biological assets intensity, firm size, listing status, regulation expertise, potential growth, leverage and sector and country-level variable – legal status.

### 3.3.1. Firm-level variables

- Biological assets intensity

As far as non-financial assets are concerned, in general, Daniel *et al.* (2010) conclude that firms tend to adopt fair value and therefore assure more value relevant[10] information to investors when intensity of non-financial assets is high. For property, plant and equipment, Christensen and Nikolaev (2013) and Hlaing and Pourjalali (2012) have also found that the likelihood of using fair value increases with the proportion of these assets to total assets. The authors state that costs of fair value outweigh the benefits when an asset represents a slight percentage of the statement of financial position.

The above considerations indicate an expected positive sign for the relation.

**H1:** Firms with more biological assets intensity are more likely to use fair value measurement model, avoiding use of the unreliability clause.

- Firm size

Regarding the positive theory of accounting policy choice, Zmijewski and Hagerman (1981) conclude that size is significantly linked to the choice of a firm's income strategy. Moreover, larger firms denote higher agency costs (Jensen and Meckling, 1976) and have equally the required resources and desirable motivations to act in accordance with accounting standards (Cairns *et al.*, 2011), which in this study means measuring biological assets at fair value.

Bearing in mind non-financial assets, Daniel *et al.* (2010) present two opposite perspectives related to firm size. On one hand, smaller firms are expected to be more reluctant to choose fair value because the implicit cost is higher for them. On the other

[10]According to Barth and Clinch (1998:200) "value relevant" means that "the amount has a significant relation in the predicted direction with share prices or the non-market-based estimate of firm value".

hand, smaller firms could be inclined to adopt fair value in order to reduce the information asymmetry between investors and managers. Quagli and Avallone (2010) also confirm that the variable size, as a proxy to political costs, reduces the likelihood of using fair value in investment property.

Because of the mixed empirical evidence in prior literature, there is no strong expectation regarding the sign of this variable.

**H2:** There is an association between firm size and use of fair value measurement model.

- Listing status

Stock exchange is the "primary enforcer of accounting standards" and it is seen as a "managerial choice variable(s)" (Hope, 2003:244). Daniel *et al.* (2010) state that firms with higher levels of international operations are more interested in fair market valuations arising from their international counterparts.

The economic inferences of accounting choices drew the attention of researchers (Fields *et al.*, 2001). Taplin *et al.* (2014) have focused on a group of economic motivations in order to explain the determinants of fair valuation for investment property. For example, they have confirmed that Chinese firms listed on foreign stock exchanges are expected to use fair value for this type of assets.

The above considerations indicate an expected positive sign for the relation.

**H3:** Firms that are listed on one (or more) foreign stock exchange are more likely to use fair value measurement model, avoiding use of the unreliability clause.

- Regulation expertise

With regard to IFRS adoption, "as opposed to rules-based systems, accounting standards of the principles persuasion do not address every controversial issue at hand but keep considerable ambiguity about such major processes as record keeping and measurement" (Carmona and Trombeta, 2008:456). Therefore, this principle-based system assures a change in accountants' skills and qualifications. Taking the measurement of biological assets into consideration, a higher level of regulation expertise would facilitate recognition of fair value.

For example, for fair value measurement of non-financial assets in general, Daniel *et al.* (2010) argue that firms with more level 2 and level 3[11] inputs are more likely to choose fair value option. Both level valuations are more complex and costly regarding the absence of liquid markets. Consequently, these firms already have experience in estimating fair value and are expected to be more receptive to this measurement.

The above considerations indicate an expected positive sign for the relation.

**H4:** Firms that have higher regulation expertise are more likely to use fair value measurement model, avoiding use of the unreliability clause.

- Potential growth

Growth opportunities have a potential effect on managers' accounting choice (Daniel *et al.*, 2010). Firms include assets-in-place, with a perceptible value and investment opportunities, with a value that is subject to discretionary judgments (Myers, 1977). Two different perspectives are addressed by Missonier-Piera (2007). Firstly, firms that have more growth opportunities than assets-in-place are expected to have a lower probability of revaluating their assets comparatively to firms with more assets-in-place. This happens because revaluating assets is usually associated to fixed assets. Secondly, and regarding information asymmetry, firms with more growth prospects than assets-in-place are more familiar with their value than investors. Besides, to control activities of these firms is more challenging than controlling activities from firms composed mainly of assets-in-place. As such, and taking into account the agency theory, firms are more willing to revalue fixed assets in order to reduce information asymmetry with potential investors.

Because of the mixed empirical evidence in prior literature, there is no strong expectation regarding the sign of this variable.

[11] Regarding IFRS 13 there are three levels of inputs, namely: Level 1 inputs are quoted prices in active markets for identical assets or liabilities that the entity can access at the measurement date [IFRS 13:76]; Level 2 inputs are inputs other than quoted market prices included within Level 1 that are observable for the asset or liability, either directly or indirectly [IFRS 13:81]; Level 3 inputs are unobservable inputs for the asset or liability; [IFRS 13:86]. An entity develops unobservable inputs using the best information available in the circumstances, which might include the entity's own data, taking into account all the information that is reasonably available about market participant assumptions [IFRS 13:87-89].

**H5:** There is an association between potential growth and use of fair value measurement model.

- Leverage

Regarding the accounting choice theory, Fields *et al.* (2001) explain that contractual motivations mitigate agency costs due to the fact that settled contractual engagements assure less conflicts between agents. In particular managers tend to increase their compensation and decrease the probability of bond covenant violations by choosing accounting methods (Fields *et al.*, 2001). Therefore, the higher the ratio between debt and equity, the higher the propensity of managers to follow strategies to increase income (Watts and Zimmerman, 1990).

In terms of investment property, Christensen and Nikolaev (2013) have found that leverage is a key determinant for fair value measurement. Moreover, based on fixed-asset revaluations, Missonier-Piera (2007) supports the same relation and corresponding sign. Actually, "managers seeking to reduce financing costs may influence the accounting decisions to reduce the perceived risk of creditors, and thus reduce debt costs. (…) This choice will not only reduce information asymmetry about the assets' fair value but also will reduce leverage ratios and the related perceived bankruptcy risk" (Missonier-Piera; 2007:192).

The above considerations indicate an expected positive sign for the relation.

**H6:** Firms with a higher leverage level are more likely to use fair value measurement model, avoiding use of the unreliability clause.

- Sector

As far as industry impact is concerned, Watts (1992) defends that accounting choice also varies according to different sectors. In particular, the contractual engagements are established based on a cost-benefit analysis. As costs of such affairs change from sector to sector, accounting procedures also differ between industries. For Fields *et al.* (2001), market imperfections are also responsible for manager's accounting choice, namely agency costs, information asymmetries and externalities that influence non-contracting

parties. One example of externality is the pressure of industry organisations. Regulating accounting will assure a positive effect of the corresponding externality.

In a study supporting that financial industry is willing to adopt new norms, Demaria and Dufour (2007) confirm that the financial sector is linked to IFRS choices in French context. Transposing to the present study, the above considerations would indicate an expected positive sign for the relation in agriculture, forestry, fishing, mining and manufacturing sectors, as these are associated with biological assets.

**H7:** Firms that belong to these sectors are more likely to use fair value measurement model, avoiding use of the unreliability clause.

### 3.3.2. Country-level variable

Overall, the attempt to classify accounting systems has been a familiar issue in accounting research (Nobes and Stadler, 2013). Country classification is one possible approach, supported by the contingency theory (Doupnik and Salter, 1995).

- Legal status

The previous chapter considered the dichotomy between common law and code law countries used by La Porta *et al.* (1998) and the cluster classification (Leuz, 2010), using regulatory and reporting practice variables. Instead of adopting any pre-determined classification, this essay follows one of its frequent inputs: regulatory quality, a worldwide governance indicator by Kaufmann *et al.* (2011).

As far as biological assets are concerned, Elad and Herbohn (2011) support that firms from common law countries, such as Australia and the United Kingdom, are fair value adopters, while Elad (2004) states that in Continental Europe, historical cost is the commonly used method.

The above considerations indicate an expected positive sign for the relation.

**H8:** Firms that have a higher level of regulatory quality are more likely to use fair value measurement model, avoiding use of the unreliability clause.

The hypotheses, proxies and expected signals of independent variables introduced above are described in table 3.2. Data were collected in DataStream. The biological assets intensity (BIO) corresponds to a ratio between biological assets and total assets

multiplied by 100. In accordance with the previous chapter, firm size (SIZE) corresponds to the logarithm of total assets. Listing status (STOCK) is a dummy variable coded 1 if the firm is listed on one foreign stock exchange or multi-listed, and 0 otherwise. Regulation expertise (IFRS) corresponds to the logarithm of the number of years that each firm follows IFRS. Potential growth (GROWTH) corresponds to market capitalization divided by common equity. Leverage (LEV) corresponds to the ratio between total liabilities divided by common shareholders' equity.

**Table 3.2. Hypotheses, variable proxies and expected signals**

| Hypotheses | Variable proxies | Expected signals |
|---|---|---|
| Biological assets intensity | BIO – Biological assets (WS18277, or WS18278, or WS18258) divided by total assets (WS02999) multiplied by 100 | Positive |
| Firm size | SIZE – Logarithm of the total assets (WS02999) | No expected signal |
| Listing status | STOCK – Binary variable based on whether the firm is listed in one or more than one foreign stock exchange (WS05427) | Positive |
| Regulation expertise | IFRS – Logarithm of the number of years that each firm follows IFRS (WS07536) | Positive |
| Potential growth | GROWTH – Market capitalization divided by common equity (WS09704) | No expected signal |
| Leverage | LEV – Total liabilities divided (WS03351) by common equity (WS03501) | Positive |
| Sector | SECTOR – Dummy variable based on whether the firm belongs to sector 1, 2 or others regarding SIC code classification (WS07021) | Positive |
| Legal status | QUALITY – Governance indicator of the regulatory quality (Kaufmann *et al.*, 2011) | Positive |

Finally, Sector (SECTOR) relates to SIC code classification (two-digit division), namely: sector 1 – agriculture, forestry, fishing and mining (01-14), sector 2 – manufacturing (20-39), and other sectors. The legal status (QUALITY) is measured by worldwide governance indicators devised by Kaufmann *et al.* (2011). The indicators that are more suitable for measuring this variable are rule of law[12] and regulatory

[12] "Capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann *et al.*, 2011:223).

quality[13]. Recently, Lindahl and Schadéwitz (2013) questioned the relevance of the law variable in financial reporting practices used by La Porta *et al.* (1998). Because of this reason, the present study has selected the regulatory quality indicator as a proxy for the country-level variable. Moreover and consistently with the previous chapter, this is the only variable included in the present study related to a country approach.

## 3.4. Methodology

In order to explore probable relations between measurement practices and firm and country-level determinants, this study examines measurement practices adopted by listed firms that have biological assets in 2012. Data were collected in DataStream. Firstly, and as mentioned before, were selected countries that adopted IFRS until 2011 to avoid examining data of the year of adoption. Then, considering the corresponding selection of countries, firms that have biological assets were selected. The criterion was to follow one of the biological assets variables (WS18277: biological assets – net book value; WS18278: biological assets – gross, WS18258: biological assets – current). The result was 324 firms[14] from 33 countries and 9 different sectors. Given the fact that the annual report of each firm was analysed to identify the measurement practice, fair value or historical cost, the biological assets represented in the consolidated statement of financial position and in notes to the consolidated financial statements were compared to the information obtained through DataStream to additionally validate the study[15]. Then, and considering that the dependent variable is binary, the study has estimated two equations using a logit model, whose results are shown in the next section.

## 3.5. Results

### 3.5.1. Descriptive analysis

Table 3.3 presents the descriptive statistics for the variables employed in the study. There is a wide range of biological assets intensity (BIO) in the selection, taking into account that this variable corresponds to the ratio between biological assets and total

[13] "Capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development" (Kaufmann *et al.*, 2011:223).
[14] The selection includes 110 firms with bearer plants that will be accounted for in accordance with IAS 16 for annual periods beginning in 2016.
[15] This match has excluded 59 firms from the initial selection. Such firms, in accordance with DataStream, have biological assets, but when analysing such information in the annual report, the given amount corresponds to mineral and oil resources.

assets: the observed maximum is 92.60 and the minimum is excessively close zero; the mean is 8.86 and the median is less than 2.30. For these reasons, this seems a critical variable and given also the skewness of 2.62. However, the analysis excludes any attempt to identify and remove outliers in the case of biological assets intensity. Because this is the main variable to determine the number of firms in the selection, the decision is to maintain all firms with biological assets in order to exceed previous studies[16]. The firm size (SIZE) mean is 5.68 (median=5.58) and registers a maximum of 7.91. With regard to regulation expertise (IFRS), mean and median are similar, with less than 0.79 and it varies between 0.30 and 1.04, which means that the range of the number of years that each firm follows IFRS stands between 2 and 11. In terms of potential growth (GROWTH) and leverage (LEV), one observation was removed in each variable because both were identified as outliers, -21.19 and -17.26, respectively. The average of legal status (QUALITY) is 0.88, the median is also 0.89 and this variable lists a maximum of 1.94.

In terms of the measurement practice (FAIR), about 32% of the 324 listed firms measure biological assets at historical cost. Appendix E presents the distribution of the number of firms by country with the related measurement practice[17].

In terms of independent dummy variables, the following table provides, for both independent variables, the percentage of firms that measure biological assets at fair value. The majority of selected firms (87.04%) corresponds to firms that are not listed on any foreign stock exchange (STOCK), and 63.83% of the corresponding 282 firms measure biological assets at fair value. Taking into consideration the sector, 28.39% of selected firms relates to agriculture, forestry, fishing and mining, and 78.26% of the 92 firms measure biological assets at fair value. The frequency of the sector "Others" is presented in Appendix C.

[16] For example, Cairns *et al.* (2011), considering a sample of 228 firms listed in Australia and in the United Kingdom with regard to IFRS adoption in 2005, have concluded that mandatory requirements concerning IAS 41 have an insignificant impact in nationally, within country and between country comparability, which reflects the small number of firms with biological assets.

[17] In Appendix E, China is the most represented country (21%). No further analysis is developed based on this finding, due to the fact that this essay has no intent to perform any analysis or interpretation by individual country.

**Table 3.3. Descriptive statistics**

| Selection: 1 324 | Mean | Median | Maximum | Minimum | Std. Dev. | Skewness | Observ. |
|---|---|---|---|---|---|---|---|
| BIO | 8.86 | 2.29 | 92.60 | 0.0(1) | 14.55 | 2.62 | 321 |
| SIZE | 5.68 | 5.58 | 7.91 | 2.68 | 0.78 | 0.10 | 321 |
| IFRS | 0.73 | 0.78 | 1.04 | 0.30 | 0.21 | -0.84 | 321 |
| GROWTH | 1.55 | 1.08 | 16.35 | -3.28 | 1.74 | 3.68 | 321 |
| LEV | 1.28 | 0.88 | 16.09 | -4.92 | 1.77 | 4.27 | 321 |
| QUALITY | 0.88 | 0.89 | 1.94 | -0.26 | 0.84 | -0.15 | 321 |

| | | Frequency | Percent | Fair value (percentage) |
|---|---|---|---|---|
| FAIR | Fair value | 220 | 67.90 | - |
| | Historical cost | 104 | 32.10 | - |
| STOCK | Firm not listed on any foreign stock exchange | 282 | 87.04 | 63.83 |
| | Firm listed on one foreign stock exchange or multi-listing | 41 | 12.65 | 95.12 |
| | No label | 1 | 0.31 | 100.00 |
| SECTOR | Agriculture, forestry and fishing and mining | 92 | 28.39 | 78.26 |
| | Manufacturing | 182 | 56.17 | 60.99 |
| | Others | 50 | 15.44 | 74.00 |

Table 3.4 presents Pearson's correlation matrix between all variables. In multivariate analysis, it is commonly acknowledged that correlations between independent variables are not risky unless they exceed 0.80 or 0.90 (Gujarati, 1995). Since there are no highly correlated independent variables, all variables are maintained in the model.

**Table 3.4. Pearson's correlation**

| | BIO | SIZE | IFRS | GROWTH | LEV | QUALITY |
|---|---|---|---|---|---|---|
| BIO | | | | | | |
| SIZE | -0.113** | | | | | |
| IFRS | 0.022 | 0.020 | | | | |
| GROWTH | -0.187*** | 0.070 | 0.025 | | | |
| LEV | -0.055 | 0.166*** | -0.097* | 0.066 | | |
| QUALITY | 0.233*** | -0.014 | 0.106* | -0.318*** | -0.008 | |

Statistical significance at: *** 1% level; ** 5% level;* 10% level

At 10% of significance level, regulation expertise is negatively correlated to leverage and positively correlated to legal status variable. At 5% of significance level, biological assets intensity is negatively correlated to firm size. Finally, the table also exhibits the following findings at 1% level of significance: legal status variable is positively correlated to biological assets intensity and negatively correlated to potential growth; biological assets intensity is negatively correlated to potential growth; and firm size is positively correlated to leverage.

### 3.5.2. Logit regression model

The following logit regression model tests the country and firm-level determinants. The results are provided in table 3.5. The presence of heteroscedasticity is analysed with Huber and White's general test (White, 1980).

$$Fair = b_0 + b_1 BIO + b_2 SIZE + b_3 STOCK + b_4 IFRS + b_5 GROWTH + b_6 LEV + \\ + b_7 \sum^{j=1,2,3} SECTOR_j + b_8 QUALITY + u_i \quad (3.1)$$

Firstly, table 3.5 assures the model's feasibility by explaining the accounting choice, with a likelihood-ratio chi-squared significance at 0.000 and a McFadden R-squared of 0.374. Regarding the regression coefficients, all variables are statistically and positively significant with two exceptions. The leverage variable is not statistically significant and potential growth is statistically significant, but it has a negative coefficient, meaning that the more the ratio between market value to book value increased, the lower the logit for fair value measurement for biological assets.

Given the transformation of regression coefficients (odds ratio), this study interprets the effect that independent variables have on the probability of fair value measurement for biological assets.

For dummy independent variables, results are as follows: since listing status (STOCK) denotes 1 whether the firm is listed on one foreign stock exchange or multi-listed, or 0 otherwise, an odds ratio equal to 15.370 estimates that fair value measurement for biological assets is more than 15 times as likely to occur among firms that are listed on one foreign stock exchange or multi-listed than the other selected firms. This finding is consistent with Daniel *et al.* (2010) regarding non-financial assets, and with Taplin *et al.* (2014) in terms of investment property.

Additionally, for sector (SECTOR), the corresponding odds ratio equal to 1.914 estimates that fair value measurement for biological assets is more than 1.9 times as likely to occur among firms that belong to the agriculture, forestry, fishing, mining and manufacturing sectors than firms that belong to other sectors. Similar to this finding, Demaria and Dufour (2007) confirm that the financial sector is linked to IFRS choices in the French context.

**Table 3.5. Logit regression model**

| **Equation:** | **(3.1)** | | |
|---|---|---|---|
| Selection: | 1 324 | | |
| Included observations: | 319 after adjustments | | |
| Dependent variable: | FAIR | | |
| Standard errors & covariance: | QML (Huber/White) | | |
| Variable | odds ratio | coefficient | z-statistic |
| Constant | 0.003 | -5.875 | -4.027*** |
| BIO | 1.082 | 0.079 | 2.832*** |
| SIZE | 1.698 | 0.530 | 2.608*** |
| STOCK | 15.370 | 2.732 | 2.968*** |
| IFRS | 19.735 | 2.982 | 3.833*** |
| GROWTH | 0.805 | -0.217 | -1.938* |
| LEV | 1.091 | 0.087 | 0.903 |
| SECTOR1+SECTOR2=1 | 1.914 | 0.649 | 1.767* |
| QUALITY | 3.911 | 1.364 | 6.366*** |
| McFadden R-squared | | 0.374 | |
| Log likelihood | | -126.081 | |
| Restr. log likelihood | | -201.392 | |
| LR statistic | | 150.622*** | |
| Obs with Dep=0 | | 104 | |
| Obs with Dep=1 | | 215 | |
| Total obs | | 319 | |

Statistical significance at: *** 1% level; ** 5% level; * 10% level

For continuous variables, and starting by firm size (SIZE), the odds ratio is 1.698. Thus, for each unit increase in the logarithm of total assets (expressed in Eur'000) the odds of choosing fair value increases by 69.80%. In this case, in order to interpret the odds ratio (because the variable is expressed in logarithm form), it is possible to explain the specific effect of a unit increasing in SIZE considering the range of the variable in the study selection. For instance, an increase in firm size from 5 to 6 (expressed in logarithm of total assets) means that an increase of ($e^6$-$e^5$) x 1.000=255.016 euros increases the odds of choosing fair value by 69.80%. These results are also supported by Cairns *et al.* (2011) for biological assets.

For other continuous variables, one unit variation in each variable does not clearly explain the impact on fair value choice. Therefore, the odds ratio was transformed taking into consideration a change of 0.10 (10%).

Biological assets intensity (BIO) varies widely between almost 0 and 92.60. The odds ratio was transformed at $e^{0.079}$ =1.082, taking into consideration a change of 0.10 (10%) in the variable instead of a unit change. Because $e^{0.079/10}$ = 1.008, this means that

the odds of choosing fair value for biological assets are multiplied by 1.008 for each additional 10% variation in BIO. Hence, for each 10% increase in BIO, there is a 0.8% increase in the odds of fair value choice. This finding is consistent with Daniel *et al.* (2010) regarding non-financial assets, and with Christensen and Nikolaev (2013) and Hlaing and Pourjalali (2012) in terms of investment property.

The regulation expertise (IFRS) variable ranges from 0.30 to 1.04. Again, instead of considering the odds ratio at 19.735 ($e^{2.982}$), it is interpreted as $e^{2.982/10} = 1.347$. For each 10% increase in regulation expertise, there is a 35% increase in the odds of fair value choice. This finding is consistent with Daniel *et al.* (2010) regarding non-financial assets.

Potential growth (GROWTH) ranges from -3.28 to 16.35 in the study selection. In order to calculate the impact on the fair value choice, the odds ratio $e^{-0.217} =0.805$ was transformed, taking into consideration a change of 0.10 (10%) in the variable instead of a unit change. In this case, $e^{-0.217/10} = 0.978$ means that the odds of choosing fair value for biological assets is multiplied by 0.98 for each additional 10% variation in GROWTH. In other words, the odds of choosing fair value are reduced by (1-0.98) X 100 = 2% for each 10% increase in potential growth. Missonier-Piera (2007) has also concluded that fixed-asset revaluation in Switzerland is negatively influenced by growth opportunities.

The legal status (QUALITY) varies between -0.26 to 1.94. Because the odds ratio equal to 3.911 ($e^{1.364}$), it is interpreted as $e^{1.364/10} = 1.146$. For each 10% increase in regulatory quality, there is a 15% increase in the odds of fair value choice.

Finally, the results show that there is no relationship with leverage variable. Regarding investment property, Taplin *et al.* (2014) have found insignificant evidence to support leverage. Also, Demaria and Dufour (2007) confirm that leverage is not linked to IFRS choices in French context.

Taking into account that regulation expertise is statistically and positively significant at less than 0.01 in equation (3.1), the study has introduced the combination between this variable and the sector, improving the effect of the firms with higher regulation expertise that belong to the following sectors: agriculture, forestry, fishing, mining and manufacturing.

In this sense the model includes a second equation (3.2) and the results are provided in table 3.6. The new variable is also statistically and positively significant; moreover, the equation has improved the McFadden R-squared measure.

$$Fair = b_0 + b_1 BIO + b_2 SIZE + b_3\ STOCK + b_4\ IFRS + b_5 GROWTH + b_6 LEV + \\ + b_7 IFRS\ x \sum^{j=1,2,3} SECTOR_j + b_8 QUALITY + u_i \qquad (3.2)$$

In order to provide some robustness tests, three additional analyses were conducted. Firstly, Appendix G and Appendix H present, respectively, the correct prediction for the dependent variable and the Andrews and Hosmer-Lemeshow statistic to test the overall model (Hosmer *et al.,* 2013; Peng *et al.*, 2002; Stone and Rasp, 1991).

**Table 3.6. Logit regression model – crossed effect of regulation expertise and sector**

| **Equation:** | **(3.2)** | | |
|---|---|---|---|
| Selection: | 1 324 | | |
| Included observations: | 319 after adjustments | | |
| Dependent variable: | FAIR | | |
| Standard errors & covariance: | QML (Huber/White) | | |
| Variable | odds ratio | coefficient | z-statistic |
| Constant | 0.003 | -5.868 | -4.067*** |
| BIO | 1.083 | 0.079 | 2.842*** |
| SIZE | 1.739 | 0.553 | 2.716*** |
| STOCK | 15.792 | 2.759 | 2.961*** |
| IFRS | 15.577 | 2.746 | 3.460*** |
| GROWTH | 0.801 | -0.222 | -2.074** |
| LEV | 1.087 | 0.083 | 0.851 |
| IFRS*(SECTOR1+SECTOR2=1) | 3.226 | 1.171 | 2.432** |
| QUALITY | 3.924 | 1.367 | 6.338*** |
| McFadden R-squared | | 0.378 | |
| Log likelihood | | -125.277 | |
| Restr. log likelihood | | -201.392 | |
| LR statistic | | 152.230*** | |
| Obs with Dep=0 | | 104 | |
| Obs with Dep=1 | | 215 | |
| Total obs | | 319 | |

Statistical significance at: *** 1% level; ** 5% level;* 10% level

According to Appendix G, the logit model correctly identifies 72 percent of firms that measure biological assets at historical cost (specificity) and 90 percent of firms that measure biological assets at fair value (sensitivity). In appendix H, Andrews's statistic is statistically significant in both equations at 1% level and Hosmer-Lemeshow's

statistic is statistically significant in equation (3.1) at a 10% level and in equation (3.2) at a 5% level.

Secondly and in order to include another proxy to test country-level factor, in accordance with the previous chapter, the model included the cluster classification (Leuz, 2010) using regulatory and reporting practice variables. Table 3.7 supports that the results remain the same for both equations. This means that fair value measurement for biological assets is more likely to occur among firms that belong to cluster 1 (outsider economies) than other selected firms.

**Table 3.7. Robustness test – legal status variable: cluster**

| **Equation:** | **(3.1)** | | | **(3.2)** | | |
|---|---|---|---|---|---|---|
| Variable | odds ratio | coefficient | z-statistic | odds ratio | coefficient | z-statistic |
| Constant | 0.031 | -3.475 | -2.509** | 0.033 | -3.413 | -2.552** |
| BIO | 1.083 | 0.080 | 2.986*** | 1.085 | 0.082 | 2.969*** |
| SIZE | 1.713 | 0.538 | 2.269** | 1.765 | 0.568 | 2.441** |
| STOCK | 12.988 | 2.564 | 2.408** | 13.874 | 2.630 | 2.395** |
| IFRS | 8.134 | 2.096 | 2.571** | 5.669 | 1.735 | 2.062** |
| GROWTH | 0.539 | -0.618 | -3.539*** | 0.531 | -0.633 | -3.643*** |
| LEV | 1.016 | 0.016 | 0.169 | 1.015 | 0.015 | 0.149 |
| SECTOR1+SECTOR2=1 | 2.347 | 0.853 | 2.027** | | | |
| IFRS* (SECTOR1+SECTOR2=1) | | | | 4.627 | 1.532 | 2.625*** |
| CLUSTER1=1 | 53.517 | 3.980 | 2.349** | 55.980 | 4.025 | 2.361** |
| CLUSTER2=1 | 0.306 | -1.184 | -2.779*** | 0.303 | -1.195 | -2.770*** |
| McFadden R-squared | | 0.459 | | | 0.465 | |
| Log likelihood | | -106.234 | | | -105.161 | |
| Restr. log likelihood | | -196.382 | | | -196.382 | |
| LR statistic | | 180.296*** | | | 182.442*** | |
| Obs with Dep=0 | | 102 | | | 102 | |
| Obs with Dep=1 | | 208 | | | 208 | |
| Total obs | | 310 | | | 310 | |

Statistical significance at: *** 1% level; ** 5% level;* 10% level

Repeating this analysis with the classic country classification, namely, common law and code law countries (La Porta *et al.*, 1998), once more, fair value measurement for biological assets is more likely to occur among firms that belong to common law countries than other selected firms. However, the regulation expertise variable loses statistical significance as documented in table 3.8; therefore, the combination between regulation expertise and sector was not tested.

**Table 3.8. Robustness test – legal status variable: legal**

| **Equation:** | **(3.1)** | | |
|---|---|---|---|
| Variable | odds ratio | coefficient | z-statistic |
| Constant | 0.036 | -3.338 | -2.170** |
| BIO | 1.074 | 0.071 | 2.619*** |
| SIZE | 1.647 | 0.499 | 2.210** |
| STOCK | 11.681 | 2.458 | 2.414** |
| IFRS | 3.384 | 1.219 | 1.310 |
| GROWTH | 0.500 | -0.693 | -3.472*** |
| LEV | 1.038 | 0.037 | 0.372 |
| SECTOR1+SECTOR2=1 | 2.656 | 0.977 | 2.381** |
| LEGAL | 154.316 | 5.039 | 2.808*** |
| McFadden R-squared | | 0.437 | |
| Log likelihood | | -102.899 | |
| Restr. log likelihood | | -182.902 | |
| LR statistic | | 160.007*** | |
| Obs with Dep=0 | | 90 | |
| Obs with Dep=1 | | 209 | |
| Total obs | | 299 | |

Statistical significance at: *** 1% level; ** 5% level;* 10% level

Thirdly, given the results related to sector, firms that belong to agriculture, forestry, fishing, mining and manufacturing sectors denote higher probability to choose fair value for measuring their biological assets. With the purpose of assuring a more detailed analysis and ascertaining different behaviour according to sector, the model was re-estimated splitting the sectors. Table 3.9 shows that agriculture, forestry, fishing and mining sectors are statistically and positive significant (odds ratio of 1.914, equation (3.1) and 3.226, equation (3.2)) and manufacturing sector is statistically and negative significant[18] (odds ratio of 0.480, equation (3.1) and 0.363, equation (3.2)).

Moreover, in order to identify which subsectors that belong to agriculture, forestry, fishing and mining sectors and to manufacturing sector are responsible for these results, another analysis was performed. A 2-digit sic-code division was considered according to agricultural and manufacturing subsectors that exhibit more number of firms to avoid any biased results, as presented in table 3.10. Agriculture, forestry, fishing and mining sectors are divided in three subsectors, namely: agricultural production – crops (sic-code 01), agricultural production – livestock and animals specialties (sic-code 02) and others. Manufacturing sector is divided in three subsectors, namely, food and kindred

[18] An odds ratio less than 1 corresponds to a negative coefficient, as previously explained.

products (sic-code 20), paper and allied products (sic-code 26) and others. Subsector food and kindred products includes 29 firms in the subsector beverages (sic-code 208).

**Table 3.9. Robustness test – sector: agriculture versus manufacturing**

| **Equation:** | **(3.1)** | | **(3.2)** | |
|---|---|---|---|---|
| Variable | odds ratio | odds ratio | odds ratio | odds ratio |
| Constant | 0.003*** | 0.005*** | 0.003*** | 0.003*** |
| BIO | 1.082*** | 1.085*** | 1.083*** | 1.087*** |
| SIZE | 1.699*** | 1.644** | 1.739*** | 1.668** |
| STOCK | 15.364*** | 15.211*** | 15.792*** | 15.532*** |
| IFRS | 19.727*** | 22.669*** | 15.577*** | 40.476*** |
| GROWTH | 0.805* | 0.811* | 0.801** | 0.812* |
| LEV | 1.091 | 1.100 | 1.087 | 1.090 |
| SECTOR1=1 | 1.914* | | | |
| SECTOR2=1 | | 0.480** | | |
| IFRS*SECTOR1=1 | | | 3.226** | |
| IFRS*SECTOR2=1 | | | | 0.363** |
| QUALITY | 3.912*** | 3.827*** | 3.924*** | 3.868*** |
| McFadden R-squared | 0.374 | 0.379 | 0.378 | 0.379 |
| Log likelihood | -126.081 | -124.976 | -125.277 | -125.142 |
| Restr. log likelihood | -201.392 | -201.392 | -201.392 | -201.392 |
| LR statistic | 150.622*** | 152.832*** | 152.230*** | 152.500*** |
| Obs with Dep=0 | 104 | 104 | 104 | 104 |
| Obs with Dep=1 | 215 | 215 | 215 | 215 |
| Total obs | 319 | 319 | 319 | 319 |

Statistical significance at: *** 1% level; ** 5% level;* 10% level

**Table 3.10. Selection distribution**

| **SIC code classification (2-digit)** | **Nr. Firms** |
|---|---|
| 01 - Agricultural Production – Crops | 34 |
| 02 - Agricultural Production – Livestock and Animal Specialties | 27 |
| Others | 31 |
| **Agriculture, forestry and fishing and mining** | **92** |
| 20 - Food and Kindred Products (includes 29 firms in the subsector Beverages) | 98 |
| 26 - Paper and Allied Products | 27 |
| Others | 57 |
| **Manufacturing** | **182** |
| **Others** | **50** |
| Total selection | 324 |

Firstly, regarding the agricultural sector, the model was re-estimated considering two subsectors – agriculture production – crops (sic-code 01) and agriculture production –

livestock and animal specialties (sic-code 02). When analysed individually, none of the sectors is statistically significant (odds ratio of 1.702, crops and 1.239, livestock and animal specialties). Table 3.11 shows these findings.

**Table 3.11. Robustness test – sector: agriculture**

| **Equation: (3.1)** | **Crops** | **Livestock and Animal Specialties** |
|---|---|---|
| Variable | odds ratio | odds ratio |
| Constant | 0.003*** | 0.003*** |
| BIO | 1.083*** | 1.084*** |
| SIZE | 1.693*** | 1.676** |
| STOCK | 15.292*** | 15.808*** |
| IFRS | 19.792*** | 20.039*** |
| GROWTH | 0.803** | 0.805** |
| LEV | 1.091 | 1.093 |
| subSECTOR1.01=1 | 1.702 | |
| subSECTOR1.02=1 | | 1.239 |
| subSECTOR1.01oth=1 | 2.003** | |
| subSECTOR1.02oth=1 | | 2.311* |
| QUALITY | 3.911*** | 3.854*** |
| McFadden R-squared | 0.374 | 0.376 |
| Log likelihood | -126.057 | -125.709 |
| Restr. log likelihood | -201.392 | -201.392 |
| LR statistic | 150.670*** | 151.366*** |
| Obs with Dep=0 | 104 | 104 |
| Obs with Dep=1 | 215 | 215 |
| Total obs | 319 | 319 |

SubSECTOR1.01 Agricultural Production – Crops
SubSECTOR1.02 Agricultural Production – Livestock and Animal Specialties
Statistical significance at: *** 1% level; ** 5% level;* 10% level

Secondly, regarding manufacturing sector, the model was re-estimated considering two subsectors – paper and allied products (sic-code 26) and food and kindred products (sic-code 20). Although paper and allied products subsector is not statistically significant (odds ratio of 0.912), food and kindred products subsector is statistically and negative significant (odds ratio of 0.367). Therefore, and in order to assure a more bounded analysis, a 3 digit sic-code division was considered and it was identified beverages subsector (sic-code 208) as responsible for negative results (odds ratio of 0.139). A plausible explanation could be the fact that this subsector represents the firms that have bearer biological assets, which are more complex to measure due to lacking of

active markets, and therefore have a higher propensity to follow the unreliability clause of fair value. Table 3.12 supports these results.

**Table 3.12. Robustness test – sector: manufacturing**

| **Equation: (3.1)** | **Paper and Allied Products** | **Food and Kindred Products** | **Beverages** |
|---|---|---|---|
| Variable | odds ratio | odds ratio | odds ratio |
| Constant | 0.007*** | 0.006*** | 0.006*** |
| BIO | 1.082*** | 1.084*** | 1.089*** |
| SIZE | 1.575** | 1.580** | 1.569** |
| STOCK | 15.684*** | 15.172*** | 16.496*** |
| IFRS | 23.314*** | 24.909*** | 25.647*** |
| GROWTH | 0.823* | 0.822* | 0.829* |
| LEV | 1.088 | 1.101 | 1.078 |
| subSECTOR2.26=1 | 0.912 | | |
| subSECTOR2.20=1 | | 0.367*** | |
| subSECTOR2.208=1 | | | 0.139*** |
| subSECTOR2.26oth=1 | 0.441** | | |
| subSECTOR2.20oth=1 | | 0.704 | |
| subSECTOR2.208oth=1 | | | 0.654 |
| QUALITY | 3.853*** | 3.904*** | 4.510*** |
| McFadden R-squared | 0.382 | 0.385 | 0.400 |
| Log likelihood | -124.335 | -123.788 | -120.817 |
| Restr. log likelihood | -201.392 | -201.392 | -201.392 |
| LR statistic | 154.115*** | 155.208*** | 161.150*** |
| Obs with Dep=0 | 104 | 104 | 104 |
| Obs with Dep=1 | 215 | 215 | 215 |
| Total obs | 319 | 319 | 319 |

SubSECTOR2.26 Paper and Allied Products
SubSECTOR2.20 Food and Kindred Products
SubSECTOR2.208 Beverages
Statistical significance at: *** 1% level; ** 5% level;* 10% level

In the overall, only firms that belong to agriculture, forestry, fishing and mining sectors denote higher probability to choose fair value for measuring biological assets.

## 3.6. Conclusions, limitations and suggestions for future research

This chapter analyses measurement practices of 324 firms worldwide that adopted IFRS until 2011. As a main rule, IAS 41 requires biological assets to be measured at fair value less costs to sell. Ideally, firms that use the unreliability clause of fair value should correspond to firms that are unable to report biological assets at fair value. This unpretentious interpretation is explored in this study. Based on the literature and given

the obtained results, this study concludes that there are other reasons related to firm and country environment that could explain this behaviour. Firstly, and considering the agency and accounting choice theories, the suggested firm-level determinants, biological assets intensity, firm size, to be listed in one or more than one foreign stock exchange, regulation expertise and to belong to agricultural or manufacturing sectors have a significant positive impact on the probability of fair value measurement for biological assets. In particular, regarding sector, agriculture and manufacturing exhibit a different behaviour. Firms that belong to manufacturing sector tend to choose in a lesser extent the fair value to measure biological assets. Additionally, potential growth has a significant negative impact on fair value measurement practice. Moreover, the results do not corroborate the theoretical background related to leverage. Secondly, based on the contingency theory, results corroborate the country-level hypothesis. Firms that belong to more developed countries, according to governance indicators (Kaufmann *et al.*, 2011) are more likely to use fair value measurement model, avoiding use of the unreliability clause. The study highlights the positive and combined impact between regulation expertise and sector with fair value measurement for biological assets.

This essay has some limitations. Firstly, this study focuses on the impact of specific firm determinants over measurement practices, but there are maybe other relevant variables to consider, such as profitability and ownership concentration. Secondly, one cannot guarantee that results would hold when using different firm and country classifications that the ones applied in this study.

Regarding future research on this area, other links could be explored, such as the relationship between measurement and disclosure practices. Furthermore, it could be analysed how the impact of environmental regulations at the country-level influences firms' incentives to adopt fair value with respect to IAS 41.

In spite of these constraints, this research provides important contributions to the literature in this area: this essay has extended studies to a worldwide selection, assuring that a larger number of countries and determinants with recent data are included. Given the recent review process of IAS 41, this study raises awareness of standard setters concerning the limitations of measurement practices of biological assets. Overall, all other stakeholders benefit from this essay because they will be better informed about measurement practices and its determinants.

# CHAPTER 4

# Value Relevance of Biological Assets under IAS 41

## 4.1. Introduction

Fair value relevance is a widely discussed issue in the literature (Mala and Chand, 2012; Laux and Leuz, 2010; Hitz, 2007; Ball, 2006; Cairns, 2006; Barlev and Haddad, 2003; Barth *et al.*, 2001; Holthausen and Watts, 2001). Even though fair value is responsible for the volatility of results and for stimulating some managerial discretion, it also incorporates more information into financial statements. Given the previous chapters, where disclosure and measurement matters were examined, in order to explore investors' perception of this additional information, it is important to differentiate recognition and disclosure (Kun, 2013; Ahmed *et al.*, 2006; Ball, 2006; Davis-Friday *et al.*, 1999). In particular, to recognise an amount and to disclose an amount, both are means to assure the decision-usefulness of financial statement information (Badenhorst *et al.*, 2015).

In general and according to Choudhary (2011), recognised values settled by managers and revised by auditors have different requirements when compared to disclosed values; consequently, investors value recognised values more than disclosed ones. This is especially useful for standard-setters in order to decide upon recognition and disclosure. According to Al Jifri and Citron (2009) the empirical evidence on the value relevance of disclosure is diversified and actually accounting regulators tend to elect recognition over disclosure.

The academic research and the intense debate regarding fair value is frequently concerned with financial instruments, but IAS 41 requirements of fair valuation bring this discussion into agricultural context (Argilés *et al.*, 2011). In particular, "IAS 41 is a "true" fair value standard: the fair value of biological assets is reported on the firm's balance sheet and any change in the fair value of the biological assets over the reporting period is recognised in periodic income as an unrealized gain or loss" (Huffman, 2013:2).

In fact, the introduction of fair value in agriculture for all biological assets has led standard setters to depart from previous accounting practices. Some evidence supports that fair value is more reliable in the decision-making process of agents within agriculture context (Argilés Bosh *et al.*, 2012). However, the standardization assured by IAS 41 in this domain is not capable to mitigate the subjective process of fair valuation (Machado *et al.*, 2015). In particular, the main disadvantage of fair value is the absence

of active markets for some biological assets. In this case, and with regard to the diversity of fair valuation models, it is possible for firms to use accounting for their own interests (Gabriel and Stefea, 2013). Moreover, Martins *et al.* (2012) highlight that each biological asset has its own attributes and life-cycles, which means that the corresponding valuation is more difficult to achieve.

Based on previous considerations, this essay focuses on the following research questions:

- Are biological assets at fair value value relevant under IAS 41?
- Is there a difference in the value relevance of biological assets between listed firms with high and low disclosure level on biological assets?

In order to address these questions, this study adjusts the original accounting-based valuation model developed by Ohlson (1995) and analyses panel data drawn from a worldwide selection composed of 132 firms from 27 IFRS adopting countries[19] and 8 sectors, between 2011 and 2013. Taking into consideration previous studies, this essay presents extensive research based on a considerable number of countries with recent data concerning a standard that was recently under discussion.

The study is structured as follows: Section 4.2 provides a literature review, firstly by focusing on the debate of fair value relevance under international financial reporting, and then applied to non-financial assets and biological assets in particular. Section 4.3 introduces the hypotheses and explains the disclosure index. Section 4.4 describes the methodology, presents the selection and the research model. Section 4.5 discusses the findings of the empirical analysis. Lastly, the final section provides a brief conclusion.

## 4.2. Literature review

### 4.2.1. Fair value relevance under international financial reporting

In general, value relevance research infers about how accounting information is reflected in the share prices and influences investors' decision-making (Barth *et al.*, 2001). Furthermore and in response to the comment of Holthausen and Watts (2001:3), supporting that "the value-relevance literature's reported associations between

[19] The countries are Australia, Belgium, Brazil, Chile, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Kenya, Lithuania, Netherlands, New Zealand, Norway, Papua New Guinea, Peru, Philippines, Portugal, South Africa, Spain, Sweden, Ukraine and the United Kingdom.

accounting numbers and common equity valuations have limited implications or inferences for standard setting", Barth *et al.* (2001) argue that the incorporated financial data in accounting records reflect relevant information not only for investors but also for accounting regulators and all stakeholders of the firm.

In fact, incorporating more information into financial statements seems to be the most important advantage of fair value accounting according to several authors (Mala and Chand, 2012; Ball, 2006; Barlev and Haddad, 2003; Barth *et al.*, 2001). In particular, fair value covers more information than historical cost whenever there is either an observable market price that managers cannot adjust or an independently observable and reliable estimate of market price (Ball, 2006).

The increase of up-to-date and relevant information with higher level of transparency improves investor self-reliance in capital markets. Fair value represents the amount that an asset can be bought or sold and assures more information related to the corresponding risk. As a consequence, investors can implement higher market controls and actively react accordingly to firms' decisions (Mala and Chand, 2012). Ideally, better financial information induces some potential benefits for investors, such as reduced risks and reduced cost of capital.

Moreover, Cairns (2006:21) argues that "those who criticise the limited use of fair values in IFRS should question their application of national GAAP (Generally Accepted Accounting Principles) and whether previous financial statements really had the qualities they claimed". Nonetheless, there are also some well-known disadvantages related to fair value accounting.

The recognised fair value changes in capital or in profit and loss are responsible for the higher volatility of reported results, hiding the value creation process (Mala and Chand, 2012). Even though volatility becomes a disadvantage to investors if it represents managerial discretion, Ball (2006) also defends that volatility should not be a problem whenever it reproduces timely incorporation of new information in earnings.

Some authors go further in the criticism by supporting that fair value accounting may have been responsible for the recent financial crisis. Laux and Leuz (2010) argue that because fair value-based models may not be reliable, fair value accounting may have contributed to the procyclicality of financial system, exacerbating inherent fluctuations and, in severe cases, causing a downward spiral in financial markets.

Furthermore, when a liquid market price is not available, "mark to market" accounting leads to "mark to model" accounting, with several valuation models, such as the present value (discounted cash flow) method and the methods adapted from the original Black-Scholes model (Black and Scholes, 1973). These fair value models are based on specific parameters and assumptions that could lead to management manipulation (Mala and Chand, 2012; Hitz, 2007; Ball, 2006). In fact, given fair value measurement, Fargher and Zhang (2014) state that when accounting standards allow managerial discretion, this opportunity is unscrupulously used by managers in practice and will compromise the relevance of financial reporting. Therefore, if users of financial information consider untrustworthy the corresponding information, they will not value this information as meaningful (Fargher and Zhang, 2014). Even though a liquid market price is able to reduce the opportunity for discretion by managers, Ball (2006) highlights that market liquidity could also lead to another problem, when the spreads are higher enough to raise uncertainty about fair value in financial statements.

For non-financial assets, such as investment property and biological assets, sometimes a market price is not available, which makes fair value assessment more difficult. Fair value relevance of non-financial assets and biological assets, in particular, will be explained in the next subsection.

### 4.2.2. Fair value relevance of non-financial assets

Considering biological assets, Lefter and Roman (2007) argue that the transformation process is directly reflected in financial reporting and consequently investors have the opportunity to calculate the future economic profit. There are some papers that discuss the impact of accounting information on the investors' decision-making, where biological assets are concerned. The results are not consensual (Huffman, 2013; Machado *et al.*, 2013; Silva Filho *et al.*, 2013; Argilés *et al.*, 2012; Martins *et al.* 2012; Argilés *et al.*, 2011).

Given a sample of 45 firms of European countries, in 2008, Martins *et al.* (2012) have concluded that fair value accounting is recognised as not relevant in biological assets domain in terms of the impact that accounting information has on the investors' decision-making. They are more interested in firms' financial performance as a whole. Conversely, by leading an experiment with students, farmers and accountants engaged

with the agricultural sector in Spain, Argilés Bosh *et al.* (2012) have matched the constraints that arise from measuring both valuation methods for biological assets, historical cost and fair value. The findings suggest that fair value is more reliable in the decision-making process of agents in the agricultural sector. Moreover, fair value seems to be more suitable for accounting preparation than historical cost. Furthermore, Argilés *et al.* (2011) have suggested that less reliable measurement under fair value would be expected, since market prices reflect significant variations in the agricultural sector. Based on 347 Spanish firms from 1995 to 2006, and given the importance of random factors derived from climate and market conditions in agriculture, the empirical evidence supports no difference in the relevance of accounting information from both valuation methods, in the sense that fair value is not responsible for higher unpredictability and volatility for future earnings and cash flows.

Based on 25 listed firms from Brazil, for 2008 and 2009, Machado *et al.* (2013) have concluded that replacing historical cost with fair value for biological assets measurement was not relevant to accounting information users. Conversely, Silva Filho *et al.* (2013) support that both historical cost and fair value measurements of biological assets are relevant to Brazilian capital market. Additionally, it is noteworthy that replacing historical cost with fair value, when measuring such assets, is beneficial to market, from an informational point of view, since the difference between the estimated market value and accounting numbers were lower when compared to the measurement at historical cost.

Finally, in contrast to previous academic discussion concerning asset measurement, which focuses exclusively on fair value or historical cost, Huffman (2013) has examined whether asset measurement related to asset use assures more value relevant information to investors. Regarding generated value, an asset can be classified as an in-exchange asset, which represents a consumable biological asset (for example, a plantation to produce timber logs) or as an in-use asset, which represents a bearer biological asset (for example, a plantation to produce palm oil). Previously, Littleton (1935) has stated that the information is more relevant for investors if fair value is applied to in-exchange assets and historical cost is applied to in-use assets. Based on a sample of 183 international firms from 35 countries that adopt IAS 41, in 1999-2001 and 2007-2010, Huffman (2013) has concluded that book value and earnings

information is more value relevant when consumable biological assets are measured at fair value and bearer biological assets are measured at historical cost.

Because there are few studies on fair value accounting concerning biological assets measurement and the scope of the studies is narrow, generally focusing on comparison between historical cost and fair value, this essay has also relied on literature where this topic is discussed for other non-financial assets (Baboukardos and Rimmel, 2014; Hamberg and Beisland, 2014; Tsoligkas and Tsalavoutas, 2011; Oliveira *et al.*, 2010; Lourenço and Curto, 2008; Barth and Clinch, 1998), such as goodwill, investment property, research and development (R&D) expenditure, tangible and intangible assets. Table 4.1 summarises the analysed papers. In order to test market valuation implications, all papers have the applied methodology in common, an adaptation of the Ohlson model (Ohlson, 1995), further explained in section 4.4 (with the exception of Hamberg and Beisland (2014), which adopts a typical return model). Overall, non-financial assets measured at fair value are value relevant, and sometimes this evidence occurs independently of the country classification (common law or code law). Some papers suggest that corresponding mandatory disclosure is also a disciplinary element of the market's perception. Moreover, in the absence of a market price, usually, managers act in self-interest.

## 4.3. Development of hypotheses

Based on previous studies, this essay focuses on the following two research questions:

- Are biological assets at fair value value relevant under IAS 41?
- Is there a difference in the value relevance of biological assets between listed firms with high and low disclosure level on biological assets?

This study tests the value relevance of recognised biological assets, which is explored under the theory of asymmetric information (Glaum et al., 2013; Hitz, 2007; Healy and Papelu, 2001).

**Table 4.1. Literature review**

| Paper | Assets | Selection | Hypotheses | Main conclusions |
|---|---|---|---|---|
| Baboukardos and Rimmel (2014) | Goodwill | 76 firms<br>Greece<br>2014 | H1: Purchased goodwill under IFRS is value relevant.<br>H2: There is a difference in goodwill's value relevance between firms with high and low disclosure level compliance under IFRS. | Fair value measurement of goodwill under IFRS assures relevant information in Greece (code law country).<br>For firms with high (low) disclosure compliance under IFRS, goodwill has a strong effect (no effect) on the equities' market valuation. |
| Hamberg and Beisland (2014) | Goodwill | 2052 firm year observations<br>Sweden<br>2001-2010 | H1: Goodwill amortizations determined under Swedish GAAP are not value relevant.<br>H2: Value relevance of goodwill impairments determined under Swedish GAAP differs from value relevance of goodwill impairments settled under IFRS 3 – Business Combinations. | Goodwill amortizations are not associated with stock returns.<br>Conversely the period before IFRS adoption, impairments are no longer statistically related under IFRS 3 (impairment is perceived as a decreased value by market participants when it occurs in addition to amortizations and managers are motivated to prevent the impairment of goodwill). |
| Tsoligkas and Tsalavoutas (2011) | R&D expenditure | 418 firm year observations<br>United Kingdom<br>2005-2007 | H1: Capitalised and expensed R&D expenditure are value relevant in the United Kingdom, after 2005.<br>H2: There are different valuation effects of R&D reporting between large and small firms in the United Kingdom, after 2005. | There is a positive (negative) and significant association between capitalised (expensed) R&D and market values.<br>R&D expenses are negatively value relevant only for large firms (informing investors on whether the research expenditure indicates expenses on no successful projects that will not assure future benefits to firms). |

| Paper | Assets | Selection | Hypotheses | Main conclusions |
|---|---|---|---|---|
| Oliveira *et al.* (2010) | Goodwill and intangible assets | 354 firm year observations Portugal 1998-2008 | H1: Intangible assets are value relevant.<br>H2: Value relevance of book value, earnings and recognised intangible assets under IFRS differs from value relevance of accounting information under Portuguese GAAP. | Intangible assets are associated with stock price.<br>IFRS adoption had no impact on the value relevance of identifiable intangibles and a positive effect on the value relevance of goodwill. Value relevance of earnings has weakened after 2005, once accounting policy has changed. |
| Lourenço and Curto (2008) | Investment property | 224 firms European countries 2005-2007 | H1: Cost, fair value and disclosed fair value of investment property are priced differently by investors.<br>H2: Fair value of investment property in France, Germany, Sweden and the United Kingdom are priced by investors differently from each other. | Investors differentiate cost and fair value and disclosed fair value of investment property.<br>Investors do not differentiate valuation implications of fair value in Germany, the United Kingdom (Continental and Anglo-Saxon models, respectively), France and Sweden (countries with medium level of shareholder protection). |
| Barth and Clinch (1998) | Tangible and intangible assets | 250 firms Australia 1991-1995 | Relevance, reliability, and timeliness of Australian asset revaluations differ:<br>H1: Across different types of assets.<br>H2: If revaluation is determined by the firm's director or an independent appraiser.<br>H3: According the age of the revalued amount. | Upward and downward revalued tangible and intangible assets are value relevant.<br>Little evidence supports that director-based revalued amounts are less relevant than independent appraiser-based revalued amounts.<br>Timeliness is not sensitive to long-term asset revaluations. |

The research model includes the market value per share (MV) as the dependent variable that corresponds to the market price month close (three months after the fiscal year[20]) and explores several determinants that are expected to be related to, namely, book value per share, biological assets per share, earnings per share, disclosure index ranking regarding IAS 41 and control variables, firm size and sector.

In the overall, financial statements are not effective in decreasing information asymmetries, if financial reporting is tendentiously partial and not complete (Glaum *et al.*, 2013). The first research question examines the ability of biological assets to explain market equity values. Where decision usefulness is concerned, measurement undertakes an important role (Hitz, 2007), once timely information mitigates the risk of investors' valuation (Glaum *et al.*, 2013).

Although there are studies that confirm accounting information related to biological assets has impact on investors' decision-making (Silva Filho *et al.*, 2013; Argilés Bosh *et al.*, 2012; Argilés *et al.*, 2011), there are other studies that do not support value relevance in biological assets domain (Machado *et al.*, 2013; Martins *et al.*, 2012). On one hand, given the informational point of view, the replacement of historical cost to fair value in measurement of such assets was favorable to market, since difference between estimated market at fair value and accounting numbers was lower compared to measurement at historical cost. On the other hand, it seems that investors do not take into account this information in isolation when making decisions about their investments. Moreover, often fair value of biological assets is calculated on the basis of estimates, mainly through the discounted future cash flow. Therefore, measurement becomes more difficult to be understood and may be less relevant to accounting information users.

Finally, and in spite of the literature supports value relevance regarding other non-financial assets, because of mixed empirical evidence in prior literature concerning biological assets, there is no strong expectation regarding the sign of the first hypothesis:

[20] Because the fiscal year end diverges between selected firms (31st March, 30th April, 31st May, 30th June, 31st August, 30th September, 30th November and 31st December, according to WS05350 – date of fiscal year end), the market value per share (MV) variable was settled according to these dates (WS05040 – June, WS05045 – July, WS05050 – August, WS05055 – September, WS05065 – November, WS05070 – December, WS05020 – February and WS05025 – March). For example, WS05040 – market price June close corresponds to market value per share three months after fiscal year end on 31st March.

**H1:** Biological assets at fair value are value relevant under IAS 41.

In order to explore investors' perception on the incorporation of more information into financial statements, it is essential to distinguish recognition from disclosure (Kun, 2013; Ahmed *et al.*, 2006; Ball, 2006; Davis-Friday *et al.*, 1999). Additionally, "the question as to whether amounts disclosed in the notes of financial statements and those recognised on the face of the financial statements have a similar impact on share prices is an important one for accounting regulators, accounts preparers and auditors" (Al Jifri and Citron, 2009:137).

Given IASB conceptual framework, disclosure is not a substitute for recognition. To be recognised an item must have "a cost or value that can be measured with reliability" (paragraph no. 4.38.b), IASB Conceptual Framework). The same criteria are not applied for disclosed items. In this sense and by analogy to the Financial Accounting Standards Board (FASB) investors distinguish recognised items as more reliable than disclosed items (Fried, 2012). Nonetheless, Choudhary (2011) and Holthausen and Watts (2001) support that recognition suggest less reliability, since managers are more encouraged to manipulate recognised items than disclosed items. There are also other arguments that support the difference between both, such as: investors incorrectly underestimate disclosed items through lack of expertise or due to the cost of processing information (Kun, 2013; Al Jifri and Citron, 2009). Conversely, the efficient market hypothesis suggests that recognition enhances little when disclosure notes answers the investors' information (Barth *et al.*, 2003).

In this extent, this current and controversial discussion justifies the introduction of the disclosure level effect in the present study. There is also the purpose of exceeding previous value relevance studies that deals only with recognition of biological assets (Huffman, 2013). In particular, disclosure mitigates information asymmetries in capital markets and reduces the cost of capital (Glaum *et al.*, 2013; Healy and Palepu 2001). Regarding other non-financial assets, such as, human capital and in line with the United States based studies, Samudhram *et al.* (2014) have concluded that voluntarily disclosed employee costs in annual reports of listed firms are value relevant in Malaysia. However, such information should be inferred with caution, once it could suggest an alternative for managers to exercise a discretionary behaviour in respect with disclosed human capital based (Samudhram *et al.,* 2014). According to Tsalavoutas and

Dionysiou (2014) higher voluntary disclosure level supports positive valuation implications. Nonetheless, prior literature does not indicate any sign for the relationship between mandatory disclosure compliance and market valuation. For example, Leuz and Wysocki (2008:17) explain that "disclosure requirements specify which information a firm has to provide and force it to reveal this information in both good and bad times."

Transposing to biological assets context, as mentioned before, PwC (2011 and 2009) have also advised firms to perform some voluntary disclosure of biological assets as an improvement to mandatory disclosure. Bearing in mind the timber sector, the PwC (2011 and 2009) have concluded that firms have different levels of transparency concerning biological assets disclosure, and in certain cases, without discussing fair valuation assumptions, so there is a chance for further enhancement. In addition and taking into account the empirical evidence of the survey developed by Elad and Herbohn (2011), there is a lack of comparability between disclosure practices, in which French firms tend to disclose less information on biological assets than firms from Australia and the United Kingdom. Given this diversified behaviour regarding the disclosure level of biological assets, as documented in chapter 2, a different impact on market valuation can be predicted. Additionally, and regarding other non-financial assets, Baboukardos and Rimmel (2014) support value relevance of goodwill only in firms with high disclosure level.

The above considerations indicate an expected positive sign for the relation.

**H2:** Value relevance of biological assets is higher in listed firms with high disclosure level on biological assets.

The hypotheses, proxies and expected signals of independent variables introduced above are described in table 4.2. Data were collected in DataStream and in annual reports of firms between 2011 and 2013.

The book value per share (BV) is the proportioned common equity divided by outstanding shares at firm's fiscal year end. Biological assets per share (BA) corresponds to a ratio between biological assets and common shares outstanding. Earnings per share (E) represent the net income available to common equity that is used by the firm to calculate its earnings per share, divided by common shares outstanding.

**Table 4.2. Hypotheses, variable proxies and expected signals**

| Hypotheses | Variable proxies | Expected signals |
|---|---|---|
| Book value per share | BV – Book value divided by outstanding shares at the firm's fiscal year end (WS05476) | Positive |
| Biological assets per share | BA – Biological assets (WS18277, WS18278 or WS18258) divided by common shares outstanding (WS05301) | No expected signal |
| Earnings per share | E – Net income used by the firm to calculate its earnings per share (WS01751) divided by common shares outstanding (WS05301) | Positive |
| Disclosure index ranking | Dindex – Dummy variable based on whether the disclosure index regarding biological assets of each firm is below first quartile, in the middle of both quartiles, or above third quartile of the disclosure index distribution of the selection (annual report) | Positive |
| Controls | | |
| Firm size | SIZE – Logarithm of total assets (WS02999) | Positive |
| Sector | SECTOR – Dummy variable based on whether the firm belongs to sector 1, 2 or others regarding SIC code classification (WS07021) | Positive |

Disclosure index ranking (Dindex) is a dummy variable coded 1 if disclosure index regarding biological assets of each firm is below first quartile, coded 2 if it stands between first and third quartiles, and coded 3 if it is above third quartile of disclosure index distribution of selection. The annual reports of each firm between 2011 and 2013 were analysed in order to calculate the disclosure index[21].

Based on the settled disclosure index of chapter 2 and given disclosures requirements of IAS 41, in the present chapter the index was calculated with the notes to the consolidated financial statements included in annual report of those selected firms, between 2011 and 2013. As previously mentioned, this index is divided into three sections: mandatory items, non-mandatory but recommended items (both sections represent all disclosure items required by IAS 41) and non-mandatory and non-recommended items (this section corresponds to voluntary information demonstrating that firms exceeded IAS 41 disclosure requirements). Also, the disclosure index is dichotomous, unweighted and adjusted for non-applicable items. Since this essay

[21]As explained in the chapter 2, this examination was performed by one researcher. In order to assure robustness of the index calculation and to minimise possible coding bias, the researcher coded the information twice and any discrepancies were solved.

considers only firms that measure biological assets at fair value, the disclosure items of IAS 41 that focus on historical cost were omitted. Items selected to be included in the disclosure index and results are shown in the Appendix A.

The maximum number of items in the disclosure index is 27. According to Commission Regulation (EU) no. 1255/2012 of 11 December 2012, IFRS 13 is applied when another IFRS requires or permits fair value measurement or disclosures about fair value measurements. Consequently, this standard sets out amendments in several standards, such as in IAS 41, by deleting paragraphs 47 and 48. An entity shall apply amendments for annual periods beginning on or after 1 January 2013. As a result, the disclosure score, in particular for 2013, is 27 or 25, respectively.

Consequently, the total score of mandatory and voluntary disclosure index for biological assets (Index) in a firm is:

$$Index_i = \frac{\sum_{i=1}^{m} d_i}{m} \tag{4.1}$$

where $d_i = 0$ or 1, as follows: $d_i = 1$ if the item is disclosed and $d_i = 0$ otherwise; $m$ = maximum number of applicable items a firm may disclose.

The control variables are firm size (SIZE) and sector (SECTOR). Prior literature measures firm size (SIZE) in different ways. In accordance with previous chapters, in this study, firm size corresponds to the logarithm of total assets. Finally, sector (SECTOR) relates to SIC code classification (two-digit division), namely: sector 1 – agriculture, forestry, fishing and mining (01-14), sector 2 – manufacturing (20-39), and other sectors. The introduction of both variables to control for any potential effects of certain firm characteristics is supported by literature related to value relevance of other non-financial assets for size (Tsalavoutas and Dionysiou, 2014) and for sector (Hamberg and Beisland, 2014; Dahmash *et al.*, 2009).

## 4.4. Methodology

### 4.4.1. Selection

This study includes panel data drawn from a selection of 389[22] firm-year observations of listed firms that adopted IFRS until 2010, from 27 countries and 8 different sectors, between 2011 and 2013. The selection contains different amounts of both recognised biological assets in the face of financial statements and disclosed information in the notes to the consolidated financial statements under fair value measurement. Table 4.3 contains information on selection process.

**Table 4.3. Selection description**

| Firm selection | Nr. Firms |
|---|---|
| Listed firms with biological assets | 164 |
| Listed firms under historical cost valuation | -30 |
| Firms without available annual report | -2 |
| Total selection | 132 |

Data were collected in DataStream. Once more, countries were selected that adopted IFRS in the year before the analysed period, 2010, in this case. Then, considering corresponding selected countries, firms that have biological assets were selected. The criterion was to follow one of the biological assets variables (WS18277: biological assets – net book value, WS18278: biological assets – gross or WS18258: biological assets – current) and assuring that each firm has biological assets in the whole period between 2011 and 2013. Finally, thirty firms under historical cost valuation and two firms without an available annual report were removed. The total selection corresponds to 132 firms. Then and considering data from between 2011 and 2013, the study has estimated three equations using a panel least squares method that will be described in the next subsection.

### 4.4.2. Research model

In general, value relevance research examines the association between accounting amounts and equity market values. But there are also other related objectives. For

[22] There are seven missing firm-year observations, six observations regarding market value per share variable (the corresponding data are not available in DataStream) and one observation was removed from earnings per share variable because it was identified as an outlier (further explained in section 4.5.1).

example, for intangible assets, Dahmash *et al.* (2009) expect that value relevance research will assure valuable contribution to international accounting regulators, and in particular, to any further review of the accounting standards.

According to Barth *et al.* (2001), to choose which methodology to adopt, in order to examine the value relevance, depends on the research question and corresponding hypotheses and also on econometric considerations. The price models – stock price regressed on earnings per share – analyse what is reflected in firm value and return models – returns regressed on scaled earnings variables – analyse what is reflected in changes in value over a specific period of time. Usually return models are preferred to price models, since former models have less econometric problems than second models (Kothari and Zimmerman, 1995). Therefore, researchers must have more caution in statistical inference when they use price models. In order to mitigate this effect it is possible to apply White's test of heteroscedasticity-consistent standard errors (White, 1980). Nonetheless, earnings response coefficients of price models are less biased than return models. In the overall, Kothari and Zimmerman (1995) do not suggest following either price or return models exclusively. For example, Hamberg and Beisland (2014) adopt the return model and as complement the price model to examine whether firms, conducting goodwill balance reductions, experience negative stock returns and to analyse value relevance effects of book value of goodwill.

The Ohlson model (Ohlson, 1995) is an example of a price model. In general it represents firm value as a linear function of book value of equity and earnings per share. Regarding non-financial assets, such as goodwill, investment property and tangible and intangible assets, this approach was also followed by several studies (Baboukardos and Rimmel, 2014; Tsoligkas and Tsalavoutas, 2011; Oliveira *et al.*, 2010; Lourenço and Curto, 2008; Barth and Clinch, 1998). Additionally, and regarding the purpose of this research, Martins *et al.* (2012) have adopted this approach for biological assets domain, supporting that this model is effective in the ability to measure the sensitivity and the cause and effect between book value and market value of a given firm. Finally, the incorporation of disclosure in the value relevance of goodwill is also tested with this valuation model (Baboukardos and Rimmel, 2014; Al Jifri and Citron, 2009). As a consequence, to examine the value relevance of biological assets, this study adjusts the original accounting-based valuation model developed by Ohlson (1995).

In the overall, the Ohlson model is more explicit for this context, regarding the research questions introduced in this essay. Focus is on the financial statement amounts, in particular, biological assets. Consequently, and according to Barth and Clinch (1998), this model analyses market price as a summary measure of relevant information to investors and explore the ability of recognised financial statement amounts to explain this measure; in this case book value is split from biological assets effect. In what it refers to econometric concerns previously explained, it is considered White's test (White, 1980).

Return model could be used in a complementary research to investigate whether annual share returns are associated with current-year revaluations (Barth and Clinch, 1998). In this sense it would be necessary to split firm earnings from unrealised valuation gains/losses of biological assets. This information was analysed in DataStream but there is a meaningful number of missing values considering the selected firms.

Firstly, this study has submitted the dataset under a random effect model (Greene, 2012). Then the Hausman test was applied, in which the null hypothesis supports that the coefficients estimated by the random effect estimator are the same as the ones estimated by the fixed effect estimator. The results infer that a fixed effect model is the appropriate model for this selection. By following the panel least squares method, three equations are considered for the adjusted Ohlson model (Ohlson, 1995). To combine cross-sectional and time data enriches the research in the sense that it provides a higher amount of information and assures larger flexibility in modelling the individual heterogeneity (Green, 2012). Results are provided in table 4.6. In these regressions, the presence of heteroscedasticity is taken into account with White's diagonal standard errors and covariance (White, 1980). Additionally, and in order to reduce heteroscedasticity, all variables (except control variables) are deflated by the number of common shares outstanding (Barth and Clinch, 2009).

In brief, value relevance of recognised biological assets is tested in a regression where a firm's market value is a function of the book value of equity and earnings. This relation is tested in the first equation with market value per share (MV) as dependent variable, and book value per share (BV) and earnings per share (E) as independent

variables. Moreover, this first model includes two control variables, namely, firm size (SIZE) and sector where it belongs (SECTOR).

$$MV_{it} = b_0 + b_1 BV_{it} + b_2 E_{it} + b_3 SIZE_{it} + b_4 \sum^{j=1,2,3} SECTOR_{jit} + u_{it} \quad (4.2)$$

Then, in order to test the first hypothesis, in the second equation the variable book value per share (BV) is divided into two variables, book value per share excluding the biological assets per share (BV-BA), and biological assets per share (BA). Coefficient $b_2$ assures the response to value relevance of biological assets under the fair valuation of IAS 41.

$$MV_{it} = b_0 + b_1 (BV\text{-}BA)_{it} + b_2 BA_{it} + b_3 E_{it} + b_4 SIZE_{it} + b_5 \sum^{j=1,2,3} SECTOR_{jit} + u_{it} \quad (4.3)$$

Finally, and with regard to the second hypothesis, the third equation adds the effect of disclosure. In this case, the goal is to investigate whether there is a systematic difference in biological assets valuation effects between firms with relatively high and relatively low disclosure level on biological assets. The coefficient $b_5$ assures the response to value relevance of biological assets regarding mandatory and voluntary disclosure. As previously explained, Dindex is a dummy variable based on whether disclosure index regarding the biological assets of each firm is below first quartile, in the middle of both quartiles, or above third quartile of selection's disclosure index distribution.

$$MV_{it} = b_0 + b_1 (BV\text{-}BA)_{it} + b_2 BA_{it} + b_3 E_{it} + b_4 \sum^{j=1,2,3} Dindex_{jit} + b_5 \sum^{j=1,2,3} Dindex_{jit} \, x \, BA_{it} + b_6 SIZE_{it} + b_7 \sum^{j=1,2,3} SECTOR_{jit} + u_{it} \quad (4.4)$$

Descriptive statistics, the correlation of the model's variables and corresponding results of this research model are shown in next section.

## 4.5. Results

### 4.5.1. Descriptive analysis

Table 4.4 presents the descriptive statistics for all variables. The market price per share (MV) for the selection ranges from a minimum of 0.01 € to a maximum of 126.53 €. The average of book value per share (BV) is 6.59 € (median=1.59 €) and this variable lists a maximum of 148.13 €. There are four firms that exhibit a negative book value

(and as consequence, the book value per share (BV) is negative), two of them between 2011 and 2013, another one in 2011 and the other in 2013. Corresponding data were not removed, given the fact that all these firms are still in activity, without any bankruptcy context. There are also other four firms that present a higher amount of biological assets when compared to book value. This finding justifies the negative minimum value in book value less biological assets per share (BV-BA).

Biological assets per share (BA) stand in a wide range, between to close zero and 56.68 €, and list an average value of 1.70 € (median=0.16 €). Given the fact that the annual report of each firm was analysed in order to calculate the disclosure index, the biological assets represented in the consolidated statement of financial position and in notes to the consolidated financial statements were compared to the information obtained through DataStream to additionally validate the data and, in certain cases, to reduce missing values of this variable. The analysis excludes any attempt to identify and remove outliers in the case of biological assets per share. Because this is the main variable to determine the number of selected firms, the decision is to maintain all firms with biological assets, regardless of its materiality. The earnings per share (E) stands between -13.08 € and 13.88 €, with a mean of 0.50 € (median= 0.06 €). One observation (-34.53 €) was removed from this variable because it was identified as an outlier. The firm size (SIZE) for the selection ranges from a minimum of 3.96 to a maximum of 7.42, with a mean of 5.84 (median= 5.74).

**Table 4.4. Descriptive statistics**

| **Selection: 1 389** | **Mean** | **Median** | **Maximum** | **Minimum** | **Std. Dev.** | **Skewness** | **Observ.** |
|---|---|---|---|---|---|---|---|
| MV | 7.62 | 1.41 | 126.53 | 0.01 | 16.19 | 4.24 | 389 |
| BV | 6.59 | 1.59 | 148.13 | -0.47 | 15.68 | 5.88 | 389 |
| BV-BA | 4.89 | 1.23 | 92.10 | -1.64 | 11.59 | 5.39 | 389 |
| BA | 1.70 | 0.16 | 56.68 | 0.0(1) | 5.94 | 6.31 | 389 |
| E | 0.50 | 0.06 | 13.88 | -13.08 | 1.86 | 2.58 | 389 |
| SIZE | 5.84 | 5.74 | 7.42 | 3.96 | 0.76 | 0.07 | 389 |
| INDEX | 60 | 60 | 100 | 13 | 18 | -0.37 | 389 |

| | | **Frequency** | **Percent** |
|---|---|---|---|
| SECTOR | Agriculture, forestry, fishing and mining | 46 | 34.85 |
| | Manufacturing | 63 | 47.73 |
| | Others | 23 | 17.42 |
| Dindex | Below quartile 0.25 (50) | 98 | 24.75 |
| | Between quartiles 0.25 (50) and 0.75 (74) | 202 | 51.01 |
| | Above quartile 0.75(74) | 96 | 24.24 |

Regarding the dummy variables sector (SECTOR), 47.73% of the selected firms relate to manufacturing, 34.85% represent agriculture, forestry, fishing and mining, and 17.42% correspond to other sectors. The frequency of sector "Others" is presented in Appendix C. There is a wide range in disclosure index (INDEX) in the selection: the highest disclosure score obtained is 100 and the lowest is 13. The mean and the median of disclosure index are both 60. Also, 24.75% of the selection stands below first quartile, which corresponds to 50, and 24.24% stands above third quartile, which corresponds to 74.

Appendix A summarises, by disclosure item, the number of firms that disclose biological assets information. In general, results corroborate the main findings of chapter 2. Most frequently reported items are: "A reconciliation of changes in the carrying amount of biological assets between the beginning and the end of the period" (n=368; [IAS 41.50]); "This reconciliation includes desegregation" (n=368; [IAS 41.50]). This evidence is supported by Silva *et al.* (2012) for Brazilian firms. The least reported items are: "The aggregate gain or loss arising during the current period on initial recognition of agricultural produce" (n=9; [IAS 41.40]) and "The nature and extent of government grants recognised in the financial statements" (n=12; [IAS 41.57]). Additionally, and taking into consideration the disclosures that exceed the mandatory and recommended items, it may suggest that there is an opportunity for improving biological assets disclosure, as concluded by PwC (2011) for the timber sector. In the absence of disclosure, Tsalavoutas *et al.* (2014) suggest that, given the support of auditors, enforcement bodies and other agents, firms should provide an explicit statement explaining when disclosure is not material or clarifying when disclosure is unreasonable on which standard items. Therefore, this would improve firm comparability and decrease information asymmetry and across firms.

In addition, Appendix D exhibits the ranking of countries by the number of firms and their average disclosure level between 2011 and 2013. Once more, results show some discrepancy of information between firms and some lack of compliance regarding IAS 41. In order to better understand this finding and assure further improvements, there is a recent report developed by Tsalavoutas *et al.* (2014) that discloses some recommendations for other non-financial assets. Based on a sample of 544 firms worldwide for the financial year 2010-2011, one goal of the study is to examine the

level of compliance with the mandated disclosures concerning mergers and acquisitions, intangibles and impairment assets. Overall, the report states that information between firms diverges considerably and that there is some level of non-compliance with regard to these three accounting issues. Firstly, the study advises to determine if firms deliberate certain transactions not to be material enough, if the standards are not clear enough, or if firms intentionally fail to follow the mandatory disclosure requirements. In this sense, preparers, regulators and enforcement bodies need to be focused towards improvement of the disclosure level by firms and to eliminate ambiguity in the interpretation of standards in order to assure greater comparability of the information provided by firms.

Table 4.5 exhibits Pearson's rank correlation coefficients. This set of correlations shows that all the independent variables are correlated positively with stock price. In particular, book value per share (BV) and book value per share excluding the biological assets per share (BV-BA) are highly positively correlated to the dependent variable. Regarding the first hypothesis, the correlation coefficient of biological assets per share (BA) with market price per share (MV) is a preliminary signal that biological assets are value relevant on a univariate basis.

**Table 4.5. Pearson's correlation**

| | MV | BV | BV-BA | BA | E | SIZE |
|---|---|---|---|---|---|---|
| MV | | | | | | |
| BV | 0.887*** | | | | | |
| BV-BA | 0.812*** | 0.949*** | | | | |
| BA | 0.757*** | 0.789*** | 0.554*** | | | |
| E | 0.787*** | 0.733*** | 0.642*** | 0.682*** | | |
| SIZE | 0.304*** | 0.245*** | 0.297*** | 0.067 | 0.18*** | |

Statistical significance at: *** 1% level; ** 5% level;* 10% level

In multivariate analysis, it is frequently accepted that correlations between independent variables are not risky unless they exceed 0.80 or 0.90 (Gujarati, 1995). The correlation coefficients are higher than 0.90 for the following variables, book value per share (BV) and book value per share excluding the biological assets per share (BV-BA), but this has no effect on the analysis because both variables are not used in the same regressions.

### 4.5.2. Research model

Table 4.6 shows estimated coefficients of the panel least square regressions for the three equations. In general, value relevance is tested in the first equation with book value per share (BV) and earnings per share (E). The coefficient of biological assets per share (BA) assures the response to value relevance in both second and third equations. Then, value relevance of biological assets regarding mandatory and voluntary disclosure is included in the third equation and it is measured by the coefficient of the crossed variable between the disclosure index ranking (Dindex) and biological assets per share (BA). Overall, the adjusted R-squared of the three equations are 0.835, 0.838 and 0.858, respectively. This indicates that introducing biological assets and the corresponding disclosure level separately improves, even slightly, explanatory power of the model.

Regression coefficients for equation (4.2) are 0.668 and 2.608, respectively, for book value per share (BV) and earnings per share (E). Both variables are statistically and positively significant at 1% and 5%, respectively. Therefore, this result infers that both variables are associated with firms' market value.

In order to test the first hypothesis, equation (4.3) excludes biological assets per share (BA) from book value per share (BV). The regression coefficients for equation (4.3) are 0.596, 0.881 and 2.406, respectively, for book value excluding biological assets per share (BV-BA), biological assets per share (BA) and earnings per share (E). The first and second variables are statistically and positively significant at 1% and the earnings per share at 5%. Hence, this evidence confirms the first hypothesis, which states that biological assets are value relevant at fair value under IAS 41.

Regarding the second hypothesis, equation (4.4) tests whether there is a difference in the value relevance of biological assets between listed firms with high and low disclosure level on biological assets. This regression includes the interaction variable between the dummy variable related to the disclosure level (Dindex) and biological assets per share (BA). Regression coefficients for equation (4.4) are 0.668, 0.507, 2.432 and 0.797, respectively, for book value excluding biological assets per share (BV-BA), biological assets per share (BA), earnings per share (E) and the interaction variable ($Dindex_3$ x BA). These four variables are statistically and positively significant at 1%, 10%, 5% and 1%, respectively. As a result, this evidence confirms the second

hypothesis, which states that value relevance of biological assets is higher in listed firms with high disclosure level on biological assets.

**Table 4.6. Panel fixed effects regression model**

| **Equation:** | **(4.2)** | | **(4.3)** | | **(4.4)** | |
|---|---|---|---|---|---|---|
| Selection: | 2011 2013 | | 2011 2013 | | 2011 2013 | |
| Included panel observ: | 389 | | 389 | | 389 | |
| Dependent variable: | MV | | MV | | MV | |
| Variable | coef. | t-stat. | coef. | t-stat. | coef. | t-stat. |
| Constant | -10.499 | -3.567*** | -11.774 | -4.792*** | -10.271 | -3.952*** |
| BV | 0.668 | 5.597*** | | | | |
| BV-BA | | | 0.596 | 4.894*** | 0.668 | 4.234*** |
| BA | | | 0.881 | 3.221*** | 0.507 | 1.700* |
| E | 2.608 | 2.415** | 2.406 | 2.266** | 2.432 | 2.567** |
| $Dindex_1$ | | | | | 1.212 | 1.418 |
| $Dindex_3$ | | | | | -0.622 | -1.232 |
| $Dindex_1$ x BA | | | | | 1.402 | 0.912 |
| $Dindex_3$ x BA | | | | | 0.797 | 3.088*** |
| Controls | | | | | | |
| SIZE | 1.963 | 3.752*** | 2.258 | 5.734*** | 1.863 | 4.636*** |
| SECTOR1+SECTOR2=1 | 1.136 | 1.281 | 0.711 | 0.849 | 0.881 | 1.031 |
| Adjusted R-squared | 0.835 | | 0.838 | | 0.858 | |
| F-statistic | 327.428*** | | 287.464*** | | 213.358*** | |

Statistical significance at: *** 1% level; ** 5% level; * 10% level

In order to provide an additional analysis and given the classification under IAS 41, namely bearer and consumable biological assets, the selection was divided. Equation (4.4) is re-estimated using these two sub selections. Table 4.7 shows the corresponding results.

The estimated coefficients of bearer biological assets sub selection are statistically similar to those of initial multivariate analysis. In the case of consumable biological assets, the interaction variable is not supported; it seems that investors do not value recognised biological assets in firms that exhibit a higher disclosure level. Usually there is an available market price for consumable biological assets and frequently they are sold in the short term. Therefore, the fair value of consumable biological assets is captured by the market faster when compared to bearer biological assets. Moreover, bearer biological assets are held for an extended period and typically it is more difficult to access the corresponding fair value. Consequently, in this case, mandatory disclosure or any further information is useful, and for that reason, investors value bearer

biological assets for firms that reveal a higher disclosure level on biological assets.

**Table 4.7. Bearer and consumable biological assets classification**

**Panel A: Panel fixed effects regression results**

| | Bearer | | Consumable | |
|---|---|---|---|---|
| Variables | coef. | t-stat. | coef. | t-stat. |
| Constant | -20.759 | -3.957*** | -3.394 | -1.737* |
| BV-BA | 0.549 | 3.345*** | 0.821 | 8.612*** |
| BA | 0.649 | 1.943* | 1.148 | 3.247*** |
| E | 2.497 | 2.405** | 1.781 | 1.752* |
| $Dindex_1$ | 3.667 | 1.779* | -0.410 | -1.101 |
| $Dindex_3$ | -0.912 | -1.035 | -0.312 | -0.549 |
| $Dindex_1$ x BA | 4.180 | 1.327 | -1.239 | -1.376 |
| $Dindex_3$ x BA | 1.029 | 3.673*** | 0.040 | 0.117 |
| Controls | | | | |
| SIZE | 3.745 | 4.470*** | 0.689 | 2.001** |
| SECTOR1+SECTOR2=1 | 1.295 | 0.893 | -0.012 | -0.023 |
| N | 167 | | 222 | |
| Adjusted R-squared | 0.866 | | 0.878 | |
| F-statistic | 98.907*** | | 145.717*** | |

**Panel B: Chow test for equation (4.4) - all, bearer and consumable**

| Sum squared residuals | All | Bearer | Consumable |
|---|---|---|---|
| | 14077.14 | 9880.421 | 2285.219 |
| Number of parameters | 10 | | |
| Number of observations | 389 | 167 | 222 |
| F-statistic(10,369) | 5.798 | | |

Statistical significance at: *** 1% level; ** 5% level; * 10% level

In order to reinforce the previous analysis, the Chow test was used to determine whether the coefficients can differ across subgroups (Chow, 1960). Due to the fact that F statistic is 5.798, which is superior to its critical value 2.369 at 1% level of significance, the study rejects the null hypothesis of structural stability. In such context, there is a structural change in this model, and it is necessary to split data into 2 sub selections meaning that independent variables have a different impact on both bearer biological assets and consumable biological assets subgroups of the whole selection.

Based on this result, it is possible to infer that investors highly distinguish recognised biological assets under fair value between bearer biological assets and consumable

biological assets. This evidence supports, to some extent, the recent amendments to IAS 41, which prescribe a different accounting treatment for bearer plants when compared to other biological assets.

Finally and with the purpose of providing some robustness tests, two additional analyses were conducted. Firstly, table 4.8 reveals that the inferences of these equations are not sensitive to using prices as of three or six months after fiscal year-end, except in the third model. In this case, the interaction variable is not statistically significant when considering price as of six months after fiscal year-end.

**Table 4.8. Robustness test – market value six months after fiscal year-end**

| **Equation:** | **(4.2)** | | **(4.3)** | | **(4.4)** | |
|---|---|---|---|---|---|---|
| Selection: | 2011 2013 | | 2011 2013 | | 2011 2013 | |
| Included panel observ: | 386 | | 386 | | 386 | |
| Dependent variable: | $MV_{6m}$ | | $MV_{6m}$ | | $MV_{6m}$ | |
| Variable | coef. | t-stat. | coef. | t-stat. | coef. | t-stat. |
| Constant | -11.251 | -3.664*** | -12.263 | -4.806*** | -11.848 | -4.467*** |
| BV | 0.640 | 6.099*** | | | | |
| BV-BA | | | 0.584 | 4.962*** | 0.616 | 4.125*** |
| BA | | | 0.809 | 3.410*** | 0.623 | 1.947* |
| E | 2.453 | 2.714*** | 2.293 | 2.565** | 2.294 | 2.725*** |
| $Dindex_1$ | | | | | 1.401 | 1.632 |
| $Dindex_3$ | | | | | -0.341 | -0.687 |
| $Dindex_1$ x BA | | | | | 0.385 | 0.271 |
| $Dindex_3$ x BA | | | | | 0.429 | 1.558 |
| Controls | | | | | | |
| SIZE | 2.069 | 3.815*** | 2.303 | 5.570*** | 2.127 | 5.226*** |
| SECTOR1+SECTOR2=1 | 1.153 | 1.299 | 0.821 | 0.946 | 0.960 | 1.067 |
| Adjusted R-squared | 0.837 | | 0.839 | | 0.845 | |
| F-statistic | 329.571*** | | 286.921*** | | 191.682*** | |

$MV_{6m}$ – market value per share that equals the market price month close (6 months after the fiscal year)
Statistical significance at: *** 1% level; ** 5% level;* 10% level

Secondly, given the fact that biological assets per share represents a wide range of values, equations (4.3) and (4.4) were re-estimated, using a sub selection in which firms below first quartile in terms of biological assets per share in the selection are excluded. Table 4.9 shows that results are the same.

**Table 4.9. Robustness test - Firms above first quartile of biological assets per share selection's distribution**

| **Equation:** | **(4.3)** | | **(4.4)** | |
|---|---|---|---|---|
| Selection: | 2011 2013 | | 2011 2013 | |
| Included panel observ: | 289 | | 289 | |
| Dependent variable: | MV | | MV | |
| Variable | coef. | t-stat. | coef. | t-stat. |
| Constant | -11.689 | -3.565*** | -9.566 | -3.007*** |
| BV-$BA_{0.25}$ | 0.616 | 4.776*** | 0.693 | 4.118*** |
| $BA_{0.25}$ | 0.964 | 3.641*** | 0.590 | 1.902* |
| E | 1.909 | 2.020** | 1.921 | 2.388** |
| $Dindex_1$ | | | 0.837 | 0.683 |
| $Dindex_3$ | | | -0.853 | -1.642 |
| $Dindex_1$ x $BA_{0.25}$ | | | 1.875 | 0.970 |
| $Dindex_3$ x $BA_{0.25}$ | | | 0.796 | 2.920*** |
| Controls | | | | |
| SIZE | 2.268 | 4.701*** | 1.806 | 3.890*** |
| SECTOR1+SECTOR2=1 | 0.562 | 0.464 | 0.561 | 0.488 |
| Adjusted R-squared | 0.844 | | 0.865 | |
| F-statistic | 223.699*** | | 168.363*** | |

$BA_{0.25}$ – Biological assets (WS18277, WS18278 or WS18258) divided by common shares outstanding (WS05301) above first quartile of biological assets per share distribution.
Statistical significance at: *** 1% level; ** 5% level;* 10% level

## 4.6. Conclusions, limitations and suggestions for future research

Taking into consideration previous studies, this study develops an extensive research based on a considerable number of countries with recent data concerning a standard that was recently under discussion.

Value relevance research infers about how the accounting information is reflected in share prices and influences investors' decision-making (Barth *et al.*, 2001). Under the current adjustment in IAS 41, where firms will be permitted to choose either the cost model or the revaluation model for mature bearer plants according to IAS 16, for annual periods beginning on or after 1 January 2016, this essay examines market valuation implications of this standard.

Based on 389 firm-year observations of listed firms worldwide in 27 countries that adopted IFRS until 2010, this study analyses data between 2011 and 2013 under the adjusted Ohlson model (Ohlson, 1995). The empirical results support the two research hypotheses, namely, biological assets at fair value are value relevant under IAS 41 and

value relevance of biological assets is higher in listed firms with high disclosure level on biological assets.

Firstly, there is evidence that the recognised amount of biological assets under fair value model is value relevant in general. Secondly, the recognised amount of biological assets under fair value model is more value relevant for firms that exhibit a higher disclosure level. According to biological assets classification under IAS 41, the selection was divided into bearer biological assets and consumable biological assets. Results are the same, with the exception of consumable biological assets. Where consumable biological assets are concerned, the interaction variable, which introduces the disclosure level effect in biological assets valuation, is not supported; therefore, it seems that investors value recognised consumable biological assets, but independently from the corresponding disclosure level. One possible explanation would be the fact that there is usually an available market price for consumable biological assets and that usually these biological assets are sold in the short term. Moreover, bearer biological assets are held for an extended period and typically it is more difficult to access the corresponding fair value. Consequently, any further information is useful, so investors value bearer biological assets for firms that show a higher disclosure level on biological assets.

This essay has, however, some limitations. Firstly, in order to assure more robust results where panel data are concerned, the study could include data from a larger period of time. Using the period between 2011 and 2013 was the possible answer to obtain more recent data and to consider a more recent year of IFRS adoption. Secondly, with regard to the Ohlson model, there are alternative models to test this data, such as the return model. Additionally, this study has included size and sector as control variables. In this sense, further analyses could examine other firm characteristics. Regarding a more narrow scope, where disclosure index is concerned, and as clarified in chapter 2, there are no defined rules to deciding which paragraphs of IAS 41 should be grouped and which should represent one index item, as well as deciding if an item is applicable to a specific firm or not, so the information was treated according to the researchers' best judgment.

Further research could replicate this analysis to ascertain whether these results hold consistently across additional countries that adopted IFRS after 2010. It could also be

useful to investigate the extent to which market assessments of recognised versus disclosed biological assets amounts depend on the method of valuation (historical cost versus fair value). In a couple of years, considering the current discussion and subsequent amendments that are already settled in IAS 41, it could also be interesting to explore market valuation implications related to biological assets before and after 2016.

Finally, this essay seeks to help standard setters to better understand the market valuation implications of this standard in order to improve the disclosure level by firms, to eliminate ambiguity in the interpretation of IAS 41 and to assure greater comparability of the information provided by firms.

# CHAPTER 5

# Conclusions, limitations, suggestions for future research and main contributions

This concluding chapter synthesises the main findings concerning the adopted research questions, acknowledges some limitations of the study, suggests avenues for future research and states main contributions.

## 5.1. General conclusions

IFRS have been recognised as a set of high-quality accounting standards (Amiraslani *et al.*, 2013; Ball, 2006). Despite having already been adopted by almost 140 countries and other jurisdictions (IFRS Foundation, 2015), there are firm and country differences that explain the existing gap in the goal of standardization of those standards.

One of the more debated issues of IFRS consists in fair value measurement. Accounting for biological assets has engaged increased attention from researchers since the implementation of IAS 41, mostly due to the radical change that is initially introduced concerning the measurement of those type of assets. In brief, biological assets should be measured at fair value less costs to sell. Only one exemption is allowed regarding initial recognition when the corresponding market price is not available and the entity cannot assure a reliable estimate of fair value. Recently, IASB has provided an amendment in IAS 41 according to which firms will be permitted to choose either the cost or the revaluation model for mature bearer plants under IAS 16 – Property, plant and equipment, for annual periods beginning on or after 1 January 2016.

Focusing on IAS 41, this dissertation aims to identify firm and country-level determinants that explain disclosure and measurement practices of biological assets, and also to examine the value relevance of fair value of these assets.

The corresponding research questions related to firm and country-level determinants that explain mandatory and voluntary disclosure and measurement practices of biological assets under IAS 41 are described as follows:

(i) What is the disclosure level on biological assets in listed firms under IAS 41?

(ii) What firm and country-level determinants explain the differences in the disclosure level on biological assets among listed firms?

(iii) What firm and country-level determinants explain the differences in practices used to measure biological assets among listed firms?

In order to investigate market valuation implications of IAS 41, the following research questions related to value relevance of fair value of biological assets under this standard were considered in this research:

(i) Are biological assets at fair value value relevant under IAS 41?

(ii) Is there a difference in the value relevance of biological assets between listed firms with high and low disclosure level on biological assets?

Concerning the theoretical background, agency theory (Jensen and Meckling, 1976) and signalling theory (Morris, 1987) are used to explain firm-level determinants of disclosure practices. In addition, agency theory (Jensen and Meckling, 1976) and accounting choice theory (Fields *et al.*, 2001; Watts, 1992; Zmijewski and Hagerman, 1981) are used to support firm-level determinants of measurement practices. Moreover, country-level determinants of disclosure and measurement practices are explored through contingency theory (Doupnik and Salter, 1995). Finally, value relevance of biological assets under IAS 41 is supported by the theory of asymmetric information (Glaum *et al.*, 2013; Hitz, 2007; Healy and Papelu, 2001).

Summarising the results of this investigation, with regards to the disclosure level by listed firms on biological assets under IAS 41 (chapter 2), evidence shows that the corresponding index stands in a wide range of values, although the majority of disclosure items are mandatory. Results indicate that 1) firms highly disclose the reconciliation of changes of biological assets between the beginning and the end of the period with desegregation and 2) tend to ignore the requirement of disclosing the range of estimates of fair value applied to biological assets measurement.

With respect to mandatory and voluntary disclosure of biological assets, firm-level determinants, namely, biological assets intensity, firm size and to belong to agricultural and manufacturing sectors have a significant positive impact on mandatory and voluntary disclosure practices, which is supported by stakeholder, agency and signalling theories, respectively. Unexpectedly, ownership concentration also has a significant positive impact on mandatory and voluntary disclosure practices. Bearing in mind country-level determinants, two different country classifications were analysed, supported by contingency theory. Both the common law versus code law classification supported by La Porta *et al.* (1998) and a cluster classification that represents a more recent perspective introduced by Leuz (2010) are according to the theoretical

background. Firms that belong to common law countries or to outsider economies improve extent of mandatory and voluntary disclosure of biological assets.

In this field, two main findings corroborate previous studies, namely: the need to improve the disclosure level and the dichotomy common law versus code law countries regarding this research topic.

After analysing the disclosure level concerning biological assets and determinants influencing that type of disclosure (chapter 2), this study focused on measurement practices (chapter 3).

As previously mentioned, IAS 41 requires biological assets to be measured at fair value less costs to sell. Ideally, firms that measure biological assets at historical cost should correspond to firms with no conditions to report biological assets at fair value. This dissertation concludes and also supports earlier studies that claim that there are other reasons related to firm and country environment that can explain the adoption of historical cost, even when the unreliability clause of fair value does not apply.

With regard to firm-level determinants, biological assets intensity, firm size, to be listed in one or more than one foreign stock exchange, regulation expertise and to belong to agriculture or manufacturing sectors have a significant positive impact on probability of fair value measurement for biological assets, which is supported by agency and accounting choice theories. Regarding sector, individually, agriculture and manufacturing exhibit a different behaviour. Firms that belong to the agricultural sector are more likely to use fair value measurement model. Firms that belong to manufacturing sector tend to choose in a lesser extent fair value to measure biological assets. In particular, the beverages subsector corresponds to firms that have bearer biological assets, which are more difficult to measure given the absence of active markets, and consequently have a higher probability to avoid fair value measurement. Additionally, potential growth has a significant negative impact on fair value measurement practice. Furthermore, results do not corroborate theoretical background related to leverage.

Secondly, results corroborate country-level hypothesis, bearing in mind contingency theory. Firms that belong to more developed countries, according to another country classification, such as the governance indicators (Kaufmann, *et al.*, 2011), are more likely to use fair value measurement model, avoiding use of the unreliability clause of

fair value. Finally, the study highlights positive and combined impact between regulation expertise and sector with fair value measurement for biological assets.

The last part of this research consisted on testing the value relevance of measuring biological assets at fair value (chapter 4).

The empirical evidence supports that biological assets measured at fair value model are value relevant in general. Additionally, recognised amount of biological assets under fair value model is more value relevant for firms that reveal a higher disclosure level. Following IAS 41 classification of biological assets, the selection of firms was divided into bearer biological assets and consumable biological assets. Results are similar only for bearer biological assets. Investors value recognised consumable biological assets, but independently from corresponding disclosure level. Regularly for consumable biological assets there is a quoted price in the market and usually they are sold in the short term. Consequently and when compared to bearer biological assets, fair value of consumable biological assets is faster apprehended by the market. In case of bearer biological assets, they are held for an extended period and frequently it is more difficult to access the corresponding fair value. Accordingly, in this case, mandatory disclosure or any additional information is helpful, and therefore the investors value bearer biological assets for firms that exhibit a higher disclosure level of these assets.

## 5.2. Limitations

As with all research, the studies comprised in this thesis are subject to limitations. Firstly, because there was only one researcher involved in this research, inter-coder reliability cannot be guaranteed concerning the construction of the disclosure index used to measure the disclosure level of biological assets. For example, there are no defined rules to deciding which paragraphs of IAS 41 should be grouped and which should represent one index item, as well as deciding if an item is applicable to a specific firm or not, so the information was treated according to the researchers' best judgment. To minimise possible coding bias, the researcher coded the information twice and any discrepancies were solved. Secondly, this study focuses on the impact of specific firm determinants over disclosure and measurement practices, but there are maybe other relevant variables to consider, such as leverage, influencing disclosure practices or profitability and ownership concentration impacting measurement practices.

Additionally one cannot guarantee that results would hold when using different firm and country classifications that the ones applied in this study. Thirdly, taking into account value relevance of biological assets and in order to assure more robust results where panel data are concerned, the study could include data from a larger period of time. Regarding the Ohlson model, there are also alternative models to test this data, such as the return model.

## 5.3. Suggestions for future research

Several possible extensions of the empirical studies included in the dissertation are envisaged. Firstly and taking into account research of disclosure and measurement practices on causality explanation in specific segments – firm and country-level determinants, researchers must clarify the corresponding users of information that their study performs no extrapolations about other perspectives (Luft and Shields, 2014). Consequently, future research on this area could include other classifications regarding firms or countries. Additionally, other links could be explored, such as the relationship between measurement and disclosure practices in this domain. Furthermore, it could be analysed how the impact of environmental regulations at the country-level influences firms' incentives to disclosure information and to adopt fair value with respect to IAS 41. In regards to value relevance of biological assets, further research could replicate this analysis to ascertain whether results hold consistently across additional countries that adopted IFRS after 2010 and 2011. It could also be useful to investigate the extent to which market assessments of recognised versus disclosed biological assets amounts depend on the method of valuation (historical cost versus fair value).

## 5.4. Main contributions

In spite of the exposed constraints, this study provides important contributions to literature on biological assets under IAS 41. Compared to previous studies, this research analysed a wider selection of firms, ensuring that a larger number of countries and determinants related to disclosure and measurement are taken into consideration. Additionally, this thesis focused on recent data, which is particular relevant due to the recent review process of IAS 41.

In general, this study contributes to extend the current knowledge of biological assets disclosure level, disclosure and measurement determinants and constraints. The firm-

level determinants of disclosure practices are explained by agency theory (Jensen and Meckling, 1976) and signalling theory (Morris, 1987). The firm-level determinants of measurement practices are supported by agency theory (Jensen and Meckling, 1976) and accounting choice theory (Fields *et al.*, 2001; Watts, 1992; Zmijewski and Hagerman, 1981). Country-level determinants of disclosure and measurement practices are explored by contingency theory (Doupnik and Salter, 1995). Where disclosure is concerned, in addition to IAS 41, the research also included the best practices recommended by PwC in order to improve previous studies. Given the theory of asymmetric information (Glaum *et al.*, 2013; Hitz, 2007; Healy and Papelu, 2001), a particular attention was given to market valuation implications of this standard in order to improve the disclosure level by firms, to eliminate ambiguity in the interpretation of IAS 41 and to assure greater comparability of information provided by firms.

In particular, this study has contributed to support policy makers and international standard setters involved in future reviews of IAS 41. The empirical evidence provided in this thesis supports the recent amendments of IAS 41, in particular concerning the different models applied to consumable and bearer biological assets. As such, it is the researchers' belief that further academic research or maybe further projects of IASB could be extended to other bearer biological assets, rather than plants, in order to apply or not the same amendments that are effective for annual periods beginning on after 1 January 2016.

Finally and given these amendments, since agricultural produce will still be measured at fair value, this change will not completely remove volatility in profit or loss. At a first moment, bearer plants are recognised at accumulated cost. The depreciation will begin, once the corresponding asset stands in location and is ready to work. "The point at which depreciation begins is subjective and is likely to depend on the type of plant. This judgment should be clearly disclosed" (PwC, 2015:6). Firms will need to separately control the biological assets under fair value from the bearer plants on which they grow, "which may increase the complexity and subjectivity of the measurement" (Ernst and Young, 2015:11). Consequently, in a couple of years, considering the current discussion and subsequent amendments that are already settled in IAS 41, it could be also interesting to explore market valuation implications related to biological assets before and after 2016.

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# Annex A. Leuz's (2010) cluster classification

| Cluster 1 | | Cluster 2 | | Cluster 3 | |
|---|---|---|---|---|---|
| Australia | Singapore | Austria | Japan | Argentina | Pakistan |
| Canada | South Africa | Belgium | Korea (South) | Brazil | Philippines |
| Hong Kong | United Kingdom | Chile | Netherlands | Colombia | Portugal |
| Ireland | United States | Denmark | Norway | Greece | Taiwan |
| Israel | | Finland | Spain | India | Thailand |
| Malaysia | | France | Sweden | Italy | |
| New Zealand | | Germany | Switzerland | Mexico | |

Cluster membership using regulatory and reporting practice variables

# Appendix A. Disclosure index

| § | Score | Disclosure index | Disclosure level by item: Chapter 2 270 firms 2011 | Disclosure level by item: Chapter 4 132 firms 2011-2013 |
|---|---|---|---|---|
| | | *Mandatory items – the entity discloses* | | |
| 40 | | The aggregate gain or loss arising during the current period: | | |
| 40 | 1 | On initial recognition of biological assets | 14 | 27 |
| 40 | 1 | On initial recognition of agricultural produce | 5 | 9 |
| 40 | 1 | From the change in fair value less costs to sell of biological assets | 201 | 348 |
| 41 | 1 | A description of each group of biological assets | 230 | 345 |
| 42 | 1 | The description in [IAS 41.41] is narrative | 174 | 281 |
| 42 | 1 | The description in [IAS 41.41] is quantified | 204 | 287 |
| 46 | 1 | A description of the nature of an entity's activities involving each group of biological assets | 123 | 207 |
| 46 | | A description of non-financial measures or estimates of the physical quantities of: | | |
| 46 | 1 | Each group of the entity's biological assets at the end of the period | 156 | 225 |
| 46 | 1 | Output of agricultural produce during the period | 60 | 103 |
| 47 | 1/(NA)[a] | The methods and significant assumptions applied in determining the fair value of each group of agricultural produce at the point of harvest and each group of biological assets | 109 | 130 |
| 48 | 1/(NA)[a] | The fair value less costs to sell of agricultural produce harvested during the period, determined at the point of harvest | 112 | 131 |
| 49 | 1 | The information about biological assets whose title is restricted or pledged as security | 38 | 55 |
| 49 | 1 | The amount of commitments for developing or acquiring biological assets | 24 | 42 |
| 49 | 1 | The financial risk management strategies related to agriculture activity | 88 | 109 |
| 50 | 1 | A reconciliation of changes in the carrying amount of biological assets, between the beginning and the end of the period | 248 | 368 |
| 50 | 1 | This reconciliation includes desegregation | 242 | 368 |
| 54 | | Additional disclosures when the fair value cannot be measured reliably<br>The entity measures biological assets at their cost less any accumulated depreciation and any accumulated impairment losses – *the entity discloses* | | |
| 54 | 1 [a] | A description of the biological assets | 38 | - |
| 54 | 1 [a] | An explanation of why fair value cannot be measured reliably | 49 | - |
| 54 | 1 [a] | The range of estimates within which fair value is highly likely to lie | 2 | - |
| 54 | 1 [a] | The depreciation method used | 26 | - |
| 54 | 1 [a] | The useful lives or the depreciation rates used | 33 | - |
| 54 | 1 [a] | The gross carrying amount and the accumulated depreciation (aggregated with accumulated impairment losses) at the beginning and end of the period | 31 | - |
| 55 | 1 [a] | The gain or loss recognised on disposal of biological assets | 7 | - |
| 55 | 1 [a] | The impairment losses, in case of disposal | 0 | - |
| 55 | 1 [a] | The reversals of impairment losses, in case of disposal | 0 | - |
| 55 | 1 [a] | The depreciation, in case of disposal | 12 | - |

| | | | | |
|---|---|---|---|---|
| 56 | | The fair value of biological assets previously measured at cost less any accumulated depreciation and impairment losses becomes reliably measurable during the current period - *the entity discloses* | | |
| 56 | 1 [a] | A description of the biological assets | 0 | - |
| 56 | 1 [a] | An explanation of why fair value has become reliably measurable | 0 | - |
| 56 | 1 [a] | The effect of the change | 0 | - |
| 57 | | Government grants – *the entity discloses* | | |
| 57 | 1 | The government grants | 26 | 36 |
| 57 | 1 | The nature and extent of government grants recognised in the financial statements | 10 | 12 |
| 57 | 1 | Unfulfilled conditions and other contingencies attaching to government grants | 1 | 0 |
| 57 | 1 | Significant decreases expected in the level of government grants | 0 | 0 |
| | | *Non-mandatory but recommended items – the entity discloses* | | |
| 43 | | A quantified description of each group of biological assets distinguishing between: | | |
| 43 | 1 | Consumable and bearer biological assets | 56 | 75 |
| 43 | 1 | Mature and immature biological assets | 77 | 125 |
| 51 | 1 | The amount of change in fair value less costs to sell included in profit or loss due to physical changes and due to price changes | 78 | 102 |
| 51 | 1 | This information is presented by the group of biological assets | 33 | 42 |
| | | *Non-mandatory and non-recommended items – the entity discloses* | | |
| NA | 1 | The complexity of various parameters regarding the effect on the valuation (but there is limited information regarding the effect on the valuation) | 124 | 238 |
| NA | 1 | The information on the effects of variations in key factors | 53 | 103 |
| NA | 1 | The assumptions on future prices and costs, as well as disclosing a sensitivity analysis with multiple parameters | 47 | 90 |
| | 40 [a] | | | |

[a] Regarding the chapter 4 the disclosure score is 27, once the disclosure items of IAS 41 that focus on the historical cost were omitted; in particular for 2013, the disclosure score is 27 or 25, depending on the adoption of IFRS 13 by the firms of the selection.

## Appendix B. Ten firms with higher and lower disclosure level by country and sector

| Firm | Country | Sector | Index |
|---|---|---|---|
| *Higher disclosure level* | | | |
| Holmen | Sweden | Manufacturing | 1.00 |
| Forestal Cholguan | Chile | Manufacturing | 0.95 |
| Vipingo Plantations | Kenya | Agriculture, forestry, fishing and mining | 0.95 |
| Distell Group | South Africa | Manufacturing | 0.94 |
| Vina San Pedro | Chile | Manufacturing | 0.94 |
| R.E.A. Holdings PLC | United Kingdom | Agriculture, forestry, fishing and mining | 0.90 |
| Select Harvests | Australia | Manufacturing | 0.89 |
| York Timber | South Africa | Manufacturing | 0.89 |
| Stolt Nielsen | United Kingdom | Transportation and pub. utilities | 0.89 |
| Livestock Imp. Corporation | New Zealand | Agriculture, forestry, fishing and mining | 0.88 |
| | | | |
| *Lower disclosure level* | | | |
| Donegal | Ireland | Manufacturing | 0.00 |
| Kuwait Food Company | Kuwait | Retail trade | 0.00 |
| L.D.C. | France | Manufacturing | 0.00 |
| Randon | Brazil | Manufacturing | 0.00 |
| Siguldas | Latvia | Agriculture, forestry, fishing and mining | 0.07 |
| Unilever | Netherlands | Manufacturing | 0.09 |
| Pernod Ricard | France | Manufacturing | 0.13 |
| BTG PLC | United Kingdom | Manufacturing | 0.13 |
| Vealls Limited | Australia | Services | 0.17 |
| Carbon Conscious | Australia | Transportation and pub. utilities | 0.17 |

## Appendix C. Frequency of sector "Others"

| Sector (others) | Disclosure Chapter 2 Total | Measurement Chapter 3 Total | Value Relevance Chapter 4 Total |
|---|---|---|---|
| Construction | 2 | 2 | 1 |
| Transportation and pub. utilities | 5 | 10 | 6 |
| Wholesale trade | 11 | 12 | 7 |
| Retail trade | 4 | 9 | 5 |
| Finance, insurance and real estate | 7 | 10 | 2 |
| Services | 5 | 7 | 2 |
| Total | 34 | 50 | 23 |

# Appendix D. Ranking of countries by the number of firms and their average disclosure level

| Country | Disclosure Chapter 2 | | Value Relevance Chapter 4 | | | |
|---|---|---|---|---|---|---|
| | Number of firms | Disclosure Index | Number of firms | Disclosure Index | | |
| | | 2011 | | 2011 | 2012 | 2013 |
| Chile | 30 | 0.52 | 10 | 0.59 | 0.59 | 0.61 |
| Brazil | 28 | 0.59 | 15 | 0.61 | 0.63 | 0.62 |
| Australia | 25 | 0.63 | 16 | 0.59 | 0.61 | 0.61 |
| Hong Kong | 24 | 0.67 | 22 | 0.57 | 0.57 | 0.60 |
| South Africa | 20 | 0.49 | 15 | 0.57 | 0.58 | 0.59 |
| United Kingdom | 17 | 0.60 | 8 | 0.76 | 0.76 | 0.75 |
| China | 11 | 0.44 | - | - | - | - |
| New Zealand | 11 | 0.64 | 6 | 0.63 | 0.63 | 0.65 |
| France | 9 | 0.52 | 4 | 0.45 | 0.48 | 0.47 |
| Norway | 9 | 0.47 | 5 | 0.58 | 0.58 | 0.62 |
| Philippines | 8 | 0.49 | 3 | 0.64 | 0.64 | 0.67 |
| Greece | 7 | 0.63 | 3 | 0.52 | 0.52 | 0.58 |
| Spain | 7 | 0.39 | 3 | 0.42 | 0.42 | 0.45 |
| Germany | 6 | 0.67 | 1 | 0.78 | 0.78 | 0.81 |
| Sweden | 6 | 0.55 | 3 | 0.78 | 0.78 | 0.79 |
| Finland | 5 | 0.65 | 3 | 0.45 | 0.45 | 0.50 |
| Luxembourg | 4 | 0.44 | - | - | - | - |
| Bermuda | 3 | 0.50 | - | - | - | - |
| Denmark | 3 | 0.61 | 2 | 0.43 | 0.41 | 0.40 |
| Ireland | 3 | 0.65 | 2 | 0.43 | 0.43 | 0.45 |
| Italy | 3 | 0.60 | 1 | 0.44 | 0.44 | 0.43 |
| Kenya | 3 | 0.77 | 1 | 0.53 | 0.53 | 0.63 |
| Netherlands | 3 | 0.57 | 1 | 0.74 | 0.74 | 0.82 |
| Portugal | 3 | 0.59 | 2 | 0.50 | 0.50 | 0.50 |
| Belgium | 2 | 0.50 | 1 | 0.82 | 0.82 | 0.87 |
| Lithuania | 2 | 0.92 | 1 | 0.76 | 0.81 | 0.84 |
| Peru | 2 | 0.58 | 1 | 0.77 | 0.77 | 0.83 |
| Ukraine | 2 | 0.50 | 1 | 0.53 | 0.53 | 0.53 |
| Cyprus | 1 | 0.27 | 1 | 0.36 | 0.36 | 0.35 |
| Oman | 2 | 0.14 | - | - | - | - |
| Russian Federation | 2 | 0.44 | - | - | - | - |
| Austria | 1 | 0.38 | - | - | - | - |
| Cayman islands | 1 | 0.50 | - | - | - | - |
| Croatia | 1 | 0.47 | - | - | - | - |
| Egypt | 1 | 0.63 | - | - | - | - |
| Faroe Islands | 1 | 0.44 | - | - | - | - |
| Kuwait | 1 | 0.00 | - | - | - | - |
| Latvia | 1 | 0.07 | - | - | - | - |
| Mauritius | 1 | 0.76 | - | - | - | - |
| United Arab Emirates | 1 | 0.71 | - | - | - | - |
| Papua New Guinea | - | - | 1 | 0.72 | 0.72 | 0.69 |
| Total | 270 | | 132 | | | |

# Appendix E. Number of firms by country with the related measurement practice

| Nation | Historical cost | Fair value | Total |
|---|---|---|---|
| Australia | 1 | 20 | 21 |
| Belgium | - | 2 | 2 |
| Brazil | 7 | 22 | 29 |
| Canada | - | 6 | 6 |
| Cayman islands | - | 1 | 1 |
| Chile | 11 | 15 | 26 |
| China | 54 | 13 | 67 |
| Denmark | - | 3 | 3 |
| Finland | - | 4 | 4 |
| France | 3 | 4 | 7 |
| Germany | 1 | 3 | 4 |
| Greece | - | 7 | 7 |
| Hong Kong | 1 | 25 | 26 |
| Ireland | - | 2 | 2 |
| Italy | 2 | - | 2 |
| Kenya | - | 2 | 2 |
| Korea (South) | 14 | 4 | 18 |
| Kuwait | 1 | - | 1 |
| Lithuania | - | 1 | 1 |
| Luxembourg | - | 5 | 5 |
| Netherlands | - | 3 | 3 |
| New Zealand | - | 10 | 10 |
| Norway | - | 5 | 5 |
| Oman | 1 | 1 | 2 |
| Peru | - | 2 | 2 |
| Philippines | 4 | 5 | 9 |
| Poland | - | 1 | 1 |
| Portugal | 1 | 2 | 3 |
| South Africa | - | 18 | 18 |
| Spain | 3 | 4 | 7 |
| Sweden | - | 9 | 9 |
| United Arab Emirates | - | 2 | 2 |
| United Kingdom | - | 19 | 19 |
| Total | 104 | 220 | 324 |

## Appendix F. Chi-squared test between biological assets and measurement practice

| | Consumable | | | | Bearer | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Count** | **Crops** | **Live** | **Other consumable** | **Sub total** | **Dairy** | **Vines** | **Other bearer** | **Sub total** | **Total** |
| Historical cost | 8 | 32 | 10 | 50 | 7 | 33 | 14 | 54 | 104 |
| Fair value | 57 | 45 | 19 | 121 | 10 | 54 | 35 | 99 | 220 |
| Total | 65 | 77 | 29 | 171 | 17 | 87 | 49 | 153 | 324 |

| **Likelihood Ratio** | **Df** | **Value** | **Prob** |
|---|---|---|---|
| All | 5 | 19.145 | 0.002 |
| Consumable | 2 | 16.272 | 0.001 |
| Bearer | 2 | 1.517 | 0.469 |

| **Measures of Association** | **Phi Coefficient** | **Cramer's V** | **Contingency Coefficient** |
|---|---|---|---|
| All | 0.230 | 0.230 | 0.225 |
| Consumable | 0.297 | 0.297 | 0.284 |
| Bearer | 0.099 | 0.099 | 0.098 |

## Appendix G. Expectation-prediction evaluation for binary specification

| **Estimated equation** | **Dep=0** | **Dep=1** | **Total** |
|---|---|---|---|
| P(Dep=1)<=C | 75 | 22 | 97 |
| P(Dep=1)>C | 29 | 193 | 222 |
| Total | 104 | 215 | 319 |
| Correct | 75 | 193 | 268 |
| % Correct | 72.12 | 89.77 | 84.01 |
| % Incorrect | 27.88 | 10.23 | 15.99 |

## Appendix H. Goodness-of-fit evaluation for binary specification

| **Statistic** | **(3.1.)** | **(3.2)** |
|---|---|---|
| Hosmer–Lemeshow | 13.943 | 16.066 |
| Prob.Chi-Sq (8) | 0.083 | 0.041 |
| | | |
| Andrews | 35.464 | 37.008 |
| Prob.Chi-Sq (10) | 0.000 | 0.000 |